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AUSTRALIAN MAMMALS: THEIR PAST AND FUTURE

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In the midst of Australia's celebration of the 150th Anniversary of white settlement, it is surely distressing for any naturalist to contemplate the drastic and irreparable changes of faunal balance that have resulted from the geologically minute period of "civilized occupation" of this great continent. It has, indeed, proved a tragic irony of natural law that the past security of isolation, which permitted a slow and remarkably varied radiation of marsupial life, now leaves the gentle and highly specialized creatures unable to cope with changed conditions and introduced enemies.

In my review (Troughton, 1932) of Australian mammalogy given while I was President of the Royal Zoological Society of New South Wales, I called attention to the fact that the need of some kind of Australian biological survey had repeatedly been urged since the time when the proposal was first strongly advocated by the late Professor Sir Baldwin Spencer (1921) at the 18th meeting of the Australasian Association for the Advancement of Science. A Committee of the Association, meeting in January, 1939, is to consider such proposals for recommendations to the various governments. As Secretary of this Committee, I have assembled the following facts regarding the past and present status of the Australian mammal fauna.

HISTORICAL CHANGES

The history of Australia's fauna is broadly divisible into three remarkably unequal periods: first, the ages prior to man's advent, when vast distributional changes may have ensued without serious check to the rich development of the marsupial array; second, the long period of aboriginal occupation during which the fauna remained almost static despite introduction of the first placental carnivore, the dingo or wild dog; third, in striking contrast, the

Contribution from The Australian Museum, Sydney, Australia.

vast destruction of faunal balance resulting from 150 years of white settlement, with the inevitable sequence of clearing for stock and crops, ordeal by fire, poison, gun, and trap, and the tragic folly of importations such as the rabbit and fox, the latter the greatest individual destroyer apart from man.

Faunal problems peculiar to Australia have arisen from prehistoric division of the continent into three very irregular zones, comprising the arid central region, a more equable hinterland which was more continuous on the eastern side, and a richer but by no means continuous coastal zone (Prescott, map, 1931). In the partly desert central region and the subcentral regions where prolonged drought is followed by sudden bounteous seasons, evolved the strangely aberrant marsupial parallel (*Notoryctes*) of the placental moles, also the jerboa-like *Antechinomys* and other specialized forms. In the intermediate zone of grassy plains and open forest, especially that of the east and south-east, there flourished an extraordinary variety of terrestrial and arboreal marsupials. In the dense forests and scrubs of the coastal mountains and alluvial flats existed an even greater and more varied population of marsupial and murine life.

The drastic changes resulting from settlement are indicated by the fact that even specialized desert forms which survived ages of violent seasonal fluctuation are now succumbing to the rabbit and fox invasion, so that if the present rate of faunal shrinkage and soil erosion were to continue unchecked, the little sand-dredging pouched-mole would eventually be one of the few marsupials remaining in the drier inland region. In the intermediate zone, once hospitable inland plains have been rendered uninhabitable to the majority of marsupials by a teeming rabbit population which, combined with past over-grazing, has led to the denudation and erosion problems that are receiving governmental attention today. In coastal regions, the clearing of great tracts of open forest on the hills and flats for orchards and dairying, has brought about a shrinkage of habitat that threatens the survival not only of the much publicised koala (*Phascolarctos*), but of many other arboreal and terrestrial forms.

It is neither intended nor justified to strike a discouraging note regarding the pastoral prospects of the country, when difficulties of irrigation and reafforestation, coupled with erosion, can be and are being overcome; but the prospect of survival of the indigenous and inter-dependent fauna and flora is truly desperate. This is particularly true of the unique marsupial population, the bulk of which can not survive without the setting aside of adequate faunal reserves; and some species may be exterminated in the near future if subjected, as in the past, to unrestricted State-wide commercial exploitation.

INTRODUCTION OF HARMFUL MAMMALS

The phenomenal increase and spread of the introduced mouse, rats, rabbit, cat and fox, even in the less hospitable areas, provides abundant

proof of the way in which exotic species thrive in new surroundings when freed from the controlling factors of their original habitat. Unfortunately, too, the majority of Australian marsupials are slow breeders, few excepting the marsupial-mice producing more than two young at a time.

The aboriginals wrought little change owing to their natural inability to cultivate and farm settled areas, while the main result of the introduction of the wild dog appears to have been the extermination on the mainland of the largest carnivorous marsupial, the "pouched-wolf" or thylacine, and its smaller ally, the "Tasmanian" devil (*Sarcophilus*).

Although the European rabbit had been known as a pest in early Roman times, its behavior under English conditions apparently provided no warning to those governing the intended settlement of Australia. A report on Australian live stock by Governor Phillip, in 1788, listed the nucleus of a rabbit population which has cost untold millions in destruction of fodder, and for fencing. In spite of the construction of thousands of miles of "rabbit-proof fences" and the fencing of individual holdings, the rabbit has spread across the inhospitable central regions to the western coast where its abundance effects a disturbance of conditions for the slow breeding marsupials (Jones, pp. 167, 287).

In inland New South Wales, however, the trail of the rabbit has been most marked in upsetting the faunal balance by crowding the marsupials from favorable haunts and by destroying the residues of sustenance which man might not have grudged the original inhabitants of the land. The trail of that faunal abomination, the poison cart, followed that of the rabbit and resulted in wholesale destruction of mammals and partly insectivorous birds. It is notable also that decaying rabbit carcases have accentuated the blow-fly pest amongst sheep, while the marked increase in grasshopper plagues is possibly the result of the destruction of insectivorous bird and mammal life.

The hunt club formed in Victoria about 1868 to introduce fox-hunting would be presented with a colossal account if charged with its due economic and faunal reckoning. Spreading slowly at first, foxes were noticed in Queensland about 1906 and were reported as plentiful about Hughenden in the northern part of that State in 1932. While collecting with C. M. Hoy of the U. S. National Museum in central South Australia in 1920, I observed a small sub-desert form of fox inhabiting the larger rabbit warrens. Any doubt of the foxes' appearance in the rich floral and faunal area of the extreme south-western corner of the continent was finally removed when Sedgwick (1937, p. 323) quoted a note from the "Western Australian" of February 1, 1937, in which it was stated that hundreds of black swans were noted about Lake Muir, with the heads and necks removed, apparently by foxes, the tracks of which were everywhere in the sand. Lake Muir was then more than twenty miles in circumference, in spite of the dry season, and it was

difficult to estimate the actual number of killed swans; but signs suggested the destruction of these birds each night. The shallow water and the swans' slowness in taking flight probably made the birds easy prey; but such carnage in an area so recently free from foxes provides evidence of the devastating effect of the fox. The only assurance for the future appears to be the establishing of reserves from which the fox is excluded. The most favorable conditions for such reserves appear to exist on the north-eastern coastal belt where the indigenous mammals have developed an immunity to the scrub ticks that have so far apparently eliminated the fox.

Finally, regarding the deplorable depredations of the domestic cat amongst the small arboreal marsupials, it is notable that a Gouldian species of marsupial-mouse (1844) obtained at the first military post of south-west Australia "was brought in to the station by a domestic cat, which is constantly in the habit of going into the bush and returning several times during the night with a small mammal or bird." Collecting personally in the region in 1921 I found feral cats everywhere; and it was painful to contemplate their activities in that rich corner of south western Australia. The quaint honey possum (*Tarsipes*) is only obtained there; at times it is killed by the dozen by domestic cats addicted to its pursuit. There also the very existence of the remarkably aberrant and helpless ant-eater (*Myrmecobius*) is threatened by both fox and cat.

ECONOMIC IMPORTANCE OF AUSTRALIAN MAMMALS

Instruction of the public in faunal matters and the need for conservation would be one of the first duties of an Australian Bureau of Biological Survey. Such an agency could properly advertise the great usefulness of many small marsupials as destroyers of insect pests and mice, and the egregious folly of considering the larger ones merely in terms of fur and hides. The inter-dependence of fauna and flora would be more difficult to demonstrate; but any adverse effect of marsupials on herbage and flora obviously results from excessive deforestation and intensive cultivation of richer areas, combined with overstocking and the presence of the rabbit.

Economic damage by terrestrial forms is thus emphasized unduly by continued shrinkage of favorable habitat, which concentrates fauna in rich areas adjacent to settlement and creates a false impression of prolific replacement of marsupial life, inviting wholesale destruction for trade or "sport." The arboreal marsupials, however, have never eliminated any form of plant life. Some of them actually assist tree growth by destroying the indigenous mistletoe as well as insect pests. The small insectivorous forms aid in the pollination of certain trees. Beyond doubt, therefore, in prehistoric times both carnivorous and insectivorous marsupials played their part in maintaining an unusually equable balance, by controlling undue increase of insect and rodent life, and even of their herbivorous fellows. In view of this, a

brief summary of the economic importance of the various groups of Australian mammals may be of general interest.

There are many references to the importance of the Family Dasyuridae in the destruction of insects, rats, and mice in Wood Jones' "Handbook to the Mammals of South Australia," and in "The Wild Animals of Australasia" by Le Souef and Burrell. The value of the fifty odd species of marsupial mice is stressed by Wood Jones' statement that havoc by insect pests would be greatly reduced if the small marsupials were not preyed upon by domestic cats; while instances are given in both works of the killing of rodents by the smallest marsupials. Recent proof of the value of a pouched mouse (*Sminthopsis*) as an insect destroyer was received from a rancher who was astonished to find a captive feeding on grasshoppers, occurring as a plague, "which it caught and ate with great relish." The larger members of this family, the "brush-tailed phascogale" and the native and tiger "cats" are destroyers of bird-life and poultry; but their depredations are probably more than balanced by their destruction of mice, rats, and rabbits.

The members of the "bandicoot" family (*Peramelidae*) are also noted as destroyers of much insect and small rodent life. In 1871 Gerard Krefft wrote that bandicoots were "excellent as destroyers of vermin, and we have noticed fifty and more mice killed by one of them in a very short time." Of the rabbit-bandicoot or "bilby" (*Macrotis*), once plentiful in inland New South Wales, and about the city of Adelaide, South Auastralia, Wood Jones writes that the early colonists' tolerance of these marsupials was due to recognition of their great use in destroying mice and insects, but that they have since been exterminated in settled areas owing to marketing of their beautiful skins.

Of the indigenous possum family (Phalangeridae), the smaller members are almost exclusively insectivorous, notably the feather-tail glider (*Acrobates*), and the "dormouse" or pigmy possums (*Cercartetus* etc.) which are recorded as eating moths, grasshoppers, cockroaches, blowflies, and even various kinds of spiders.

In the kangaroo family (Macropodidae), the so-called "musk-rat kangaroo", smallest and most primitive of living macropods, is apparently the only member with an almost exclusively insectivorous diet, although other small rat-kangaroos (Potoroinae) may consume large quantities of larvae.

Concerning the economics of the indigenous rat population, it may be said that the fifty odd distinct species are vegetarian and frugivorous bush-haunters that rarely enter habitations. Until recently they never assumed economic importance, except in the occasional plague occurrences in western Queensland and the Northern Territory (Cleland, 1918).

Lately, however, several indigenous species have become economically important in the sugar cane fields of northern New South Wales, and in the damp coastal belt of north Queensland especially, where they have assumed

the rôle of *Rattus norvegicus* as carriers of "Weil's Disease" and other parasitic infections, besides causing economic loss in despoiling cane (Gard 1935). The problems involved are giving much concern to cane-growers and health authorities who have collected hundreds of specimens, representing at least nine indigenous species.

The economic value of the insectivorous bat population of forty odd species is beyond doubt, while the destructive activities of several large fruit-bats or "flying-foxes," and attempted control, has been dealt with in a comprehensive bulletin by Ratcliffe (1931).

EXTINCT AND FADING MARSUPIALS

The following summary of facts recently brought together at the request of the Wild Life Protection Committees should make clear the facts concerning threatened or already extinct species, and confirm the vital need for the adoption of total unified Commonwealth protection for all marsupials, subject only to the declaration of brief restrictive "open seasons" locally after full investigation of alleged prejudicial increase of species.

The fifty odd species of the kangaroo family (*Macropodinae*) comprising many geographical races ranging in size from small rat-kangaroos to the giant kinds, is indisputably in need of adequate protection from both the scientific and national view. It is a fact that about 50 of the species are never likely to menace man's interests while 5 species are believed to be extinct, and at least 16 have undergone enough shrinkage of range to threaten their survival. Members of the family are especially susceptible to the dangers of settlement because of their almost entirely non-burrowing terrestrial habits.

The slow breeding abilities of the kangaroo family emphasizes the need for adequate protection of even the so-called "common" species. Even the odd half dozen species, including the giant red and grey kangaroos, which occasionally cause damage by localized concentrations owing to exceptional conditions, are definitely in need of protection from the unqualified permits for destruction, or exploitation, which now threaten their existence in all but remote regions.

Examples selected from the twenty odd extinct and rare rat-kangaroos and wallabies provide evidence that menace to survival for the majority of the kangaroo family has advanced far beyond the realm of mere theory, and emphasize the urgent need for unified general protection.

Owing to the colonists' belief that Cook's party observed kangaroos at Botany Bay, near Sydney, instead of at Cooktown about 1700 miles northward, greater general interest has attached to the eastern discovery of Captain Cook's wallaby (*Wallabia cangaru* Müller). Even so, the specific identity of Cook's kangaroo was undecided for over 160 years until Iredale and Troughton (1937) showed that it was the northern form of the beautiful whip-

tail wallaby of southeast Queensland and northeast New South Wales. Of paramount interest, and restricted habitat in the peninsular region of Cooktown, the species should be totally protected for all time, and special provision made for its conservation. Mining activities and the recent opening of a coastal route from the south has added to the risk of extermination. The tourist attraction alone of seeing Cook's original species should invoke full Governmental care for its survival. The actual danger of extermination is proved by the fate of the most elegantly beautiful of all kangaroos, the Toolache wallaby (*Wallabia greyi* Waterhouse), sealed by human folly and greed, which some measure of conservation might have checked. Once plentiful in their restricted but hospitable habitat, southeast of Adelaide, South Australia, the unfortunate creatures were hunted on horseback with dogs. Their skins were marketed in great numbers in the Melbourne and other salesrooms, until by 1910 the population was reduced to a few scattered bands. Wood Jones (p. 245) in 1924 wrote that although it is incorrect to say that this fine wallaby is extinct, because at present five or six individuals then existed, "any effort to preserve this remnant must be made immediately and with vigor if it is to be of any service whatever." The certainty of mainland extinction led to several misdirected and all too vigorous attempts (Finlayson, 1927) at rounding up the last known colony, ending in the capture of four dead or dying members of the precious remnant. These attentions raised the cupidity of an unscrupulous few, so that survivors were wantonly killed for trophies or possible sale, and the sum total of the isolated protective effort apparently is a doe, rescued from kangaroo dogs, which by now may represent the sole survivor of the species, of which there are but six skins and seven skulls in official Australian collections.

The small white-throated pademelon or scrub-wallaby (*Thylogale parma* Gould) was plentiful in the 'forties' in the Illawarra district near Sydney, where Gould noted that it was hunted by the aborigines. Its extinction now appears certain, as it was restricted to south coastal New South Wales, and the last known specimen was received at the Australian Museum in 1889. Survival of the nearest allied species on Kangaroo Island, South Australia emphasizes the vital importance of island sanctuaries for conservation.

Of the smaller and more specialized kangaroos, no less than eight species in New South Wales alone definitely need rigorous total protection, three of the rat-kangaroos and the hare-wallaby (*Lagorchestes*) being either extinct or nearly so. Even in the luxuriant scrubs of the south-west corner there has been no definite recording of two remarkable rat-kangaroos (*Potorous gilberti* and *P. platyops*) since they were described in 1841–1844 by Gould, long before the advent of the fox, so that extinction is imminent if not long ago accomplished.

The extremely varied members of the phalangerid family, too numerous

for listing, are definitely in need of total protection, under which troublesome local concentrations may be dealt with by restricted license after adequate investigation. Apart from protecting rarities, it is necessary to guard against spurious claims involving commercial exploitation, notably in regard to the "common grey" or brush-tail opossum (*Trichosurus vulpecula*). In coastal New South Wales, and adjacent parts of Victoria and Queensland, for example, further open seasons for this species must inevitably affect the survival of the much rarer related short-eared brush-tail (*T. caninus*) within its coincident but extremely limited range.

The risk of extermination for small unexploitable opossum forms of restricted range is indicated by the fate of Leadbeater's opossum (*Gymnobelideus leadbeateri*), an important phalangerid link, originally restricted to a small area of Victoria where denudation of its limited scrub habitat has apparently led to the animals' extinction. This unique marsupial is represented by barely a dozen indifferent specimens in state museums.

For the attractive but phylogenetically senile koala, perpetual universal protection is essential to its ultimate survival, not alone in New South Wales and Victoria where exploitation, denudation of habitat, and disease have brought this unique animal to the verge of extinction. It is in Queensland especially, where coastal forests of the south-east provide the last stronghold and hope of survival, that total protection should never again be withdrawn to invite a repetition of the appalling slaughter of approximately 600,000 koala by 10,000-odd licensed trappers during the open season of 1927.

Of the large terrestrial wombats (Family Vombatidae), which though less attractive are as interesting scientifically as the koala, it may be stated that these powerful marsupials have been exterminated in large areas of the southeast mainland because of their ability to break through fences in reaching new crops. Permits for destruction, however, should be restricted to localities of proven damage, as two species are verging upon extinction. Yet another has become greatly restricted in range, and local reservations in poor but suitable country are essential to the survival of the rarer kinds.

The significance of the mainland elimination, prior to settlement, of the largest living marsupial carnivore (*Thylacinus*) has already been noted, and latest reports from Tasmanian authorities indicate grave doubts for the insular survival of this unique example of parallelism. Contemplating the fate of the large and comparatively aggressive marsupial predator, no one can doubt that ultimate extinction awaits the gentle and highly specialized leaf-eating koala, or the termite-eating Mesozoic "survivor" *Myrmecobius*, failing a concerted national effort for their conservation.

With regard to the platypus, who can doubt that the animal's fate would have been sealed by the failure to apply rigid prohibition under severe penalty of interstate and overseas trading in the beautiful pelts. Even with the natural protection of its burrowing and semi-aquatic habits, the platypus has a

range that has been affected by agriculture and by the burrowing of rabbits. Regulation of trading activities would not only have protected it in the settled lowlands where adequate populations remain, but also in the mountain streams and lakes which should have been made an everlasting sanctuary.

UNIFIED CONTROL AND SURVEY ESSENTIAL

Although it is impossible to present a more comprehensive list, I think I have given indisputable proof that the only adequate practical means of providing unified protection for marsupial life throughout the Australian States is to declare total protection for all species, subject only to carefully controlled open seasons for certain kinds that tend to increase unduly under exceptional local conditions.

The ever present danger resulting from the failure of unified control, even to the platypus, is shown by rumors during 1937 that the animal was increasing to such an extent in parts of Tasmania as to have become a pest to inland fisheries by destroying ova, and that there was possibility of an "open season." Apart from its being highly probable that alleged damage to inland fisheries has been exaggerated by persons favoring exploitation of the platypus skins, the grave consequences of even local restrictive seasons are all too evident when an animal of unique trade value is involved.

The fact that mainland platypus skins would not be distinguishable from Tasmanian skins would inevitably result in untold illicit trafficking and wastage of life, which would of course be a mere repetition of what invariably occurs following the declaration of general open seasons by individual states for any exploitable marsupial. Innumerable instances might be quoted of the attrition of fauna resulting from the alternation of open seasons in adjacent states, almost invariably in the winter when the slow breeding of marsupials must proceed unchecked to sustain adequate reserves of population.

Quite recently skins of protected marsupials from Western Australia have been identified in Sydney skin stores, while skins of the harmless and beautiful bar-tailed rock-wallaby are marketed in other states, though totally protected in the native state of South Australia, where it may soon become extinct. In New South Wales, where general protection covers all members of the kangaroo family, there is no means of preventing the killing of rarer species during the opening of local restrictive seasons because of alleged damage by commoner ones. As a result we have such protective paradoxes as the recent discovery that the skin of an increasingly rare wallaby related to Cook's original species is being put to the ignoble trade use of making doll-like travesties of the even rarer koala.

It can be stated as an indisputable fact that the institution of some type of Biological Survey, advocated for many years, would be the only possible corrective for the anomalous condition of faunal control and conservation under individual state laws.

When a joint conference succeeds in reconciling constitutional difficulties,

there should be no obstacle to the formation of a Commonwealth Bureau of biological survey, probably as a branch of the Federal Council for Scientific and Industrial Research, similar to the Division of Economic Entomology, just as the United States Division of Entomology was expanded about 1886 to include birds and mammals in recognition of their economic importance.

The urgent functions of such a Commonwealth Bureau may be briefly summarized as follows:—

1. To advise the Federal and State Governments on the establishment of complete co-ordination of faunal control, including general agreement for the abolition of state-wide open seasons for any indigenous species of bird or mammal, subject only to local restrictive action where proved essential.

2. To conduct a general preliminary census of species, and carry out such intensive ecological study in any particular region as may be indicated by the census.

3. To estimate and advise on the needs of adequate faunal reservations in various regions, including "suitable" instead of entirely "poor" land, capable of sustaining a maximum variety of fauna and flora of individual regions, and providing for:—

a. Measures for the elimination and fencing-out of predatory mammals, especially the fox.

b. Adequate policing or supervision to prevent destruction by the public, or re-introduction of pests.

c. Advice on the declaration of certain small islands as perpetual sanctuaries, and the reservation of areas of larger islands against overstocking or cultivation.

4. To advise respective state authorities on the control of pests, such as rabbits and rats in cane fields.

5. To educate the public regarding the need and reasons for faunal conservation, and to encourage the fencing and proofing of crops against the natural inroads of indigenous fauna, rather than the seeking of general licenses for destruction.

6. To advise on the justifiable economic exploitation of fauna, such as excess males of the seal colonies.

7. To apply a percentage of all profits from exploitation of fauna, especially from restrictive open seasons, to the cost of faunal control.

In view of the pressing nature of this national problem of faunal control, the very real international sympathy now being shown, and the successful conclusion of the South African Convention in reconciling the view of some ten participating nationalities, it is surely possible that agreement amongst the various Australian States can achieve a similar uniformity in the control and conservation of the unique wild life. In such endeavors, the past experiences and example of the United States must prove of vital assistance.

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DISTRIBUTION OF POCKET GOPHERS (GEOMYS BREVICEPS) IN RELATION TO SOILS

By W. B. Davis, R. R. Ramsey, and J. M. Arendale, Jr.

Why is the distribution of pocket gophers so discontinuous in regions where no apparent reason is discernible? This question occurred to the senior author when he first started a study of the distribution and differentiation of *Geomys breviceps* in eastern Texas. Knowing that this rodent occurs in sandy soils, but is absent from the "black lands" of Texas, a fact that is verified readily merely by observation from an automobile, it seemed likely that a study of soil conditions might offer a solution. With this in mind, an intensive study was conducted this past spring on a small farm near College Station, Brazos County, Texas, where pocket gophers were known to occur.

The 75 acre tract of rolling land included about 75 per cent open pasture and about 25 per cent timbered and creek bottom areas; also two small garden plots from which gophers were excluded by the activities of man. Although pocket gophers were present in small numbers in the timbered areas, they were far more numerous, but spotted in their occurrence, in the open pasture. They were entirely absent from some areas that, superficially at least, appeared suited to their needs.

SOILS OF THE AREA

Three soil series with one type each, except for the Ochlockonee which has two, are present in the area. These are (1) Lufkin, represented by a fine sandy loam, (2) Wilson, a sandy loam, and (3) Ochlockonee, consisting of fine sandy loam and silt loam types.

The Lufkin fine sandy loam is the most widely distributed soil on the area. This consists of from a mere trace to 24 or more inches of grayish or grayish-brown, rather compact, fine sandy loam overlying a subsoil (B horizon) of drab colored, highly plastic, impervious clay mottled in varying degrees with yellows and reds. The subsoil has a smooth, soapy feel and is sticky when wet, becoming extremely tough and hard when dry. Because the nearly impervious nature of the subsoil prevents downward percolation of water, level areas of this soil becomes very soggy after rains. On slopes the impervious subsoil causes a rapid runoff, resulting in excessive sheet erosion wherever native vegetation has been greatly reduced by grazing, plowing, or other agencies.

The Wilson fine sandy loam is restricted in the area studied to a tract comprising about 15 acres. This soil consists of a dark gray to blackish sandy top soil about two inches in depth which overlies a black, very sticky, plastic clay. The soil and subsoil becomes very compact and hard when dry.

The Ochlockonee series includes soils that are alluvial in character and local

in origin. The fine sandy loam occurs along the upper courses of the two creeks in the area; the silt loam is found along the middle and lower courses. The sandy soil consists of a light brown loamy fine sand, from 10 to 30 inches in depth, overlying a clay or sandy clay subsoil. The silt type consists of a dark, slightly plastic silt loam overlying a clay subsoil. This type occurs in areas subjected to frequent inundation, especially during the rainy periods in winter and late spring.

METHODS

Because pocket gophers are preeminently fossorial in habit, it was felt that depth, texture and chemical composition of the soil might influence their activities. Depth of soil, particularly the top soil or A horizon, was measured in nearly every instance where gophers occurred and in numerous places where they were absent. The texture of A and B horizons (top soil and subsoil) was determined by accepted field practices, that is, by rubbing samples between the index finger and the thumb. The hydrogen ion concentration (pH value) was determined by use of the colorimetric Soiltex soil testing kit: no complete chemical analysis was attempted.

The depth of the burrow was measured in inches from the surface of the ground to the bottom of the burrow. In each instance the vertical diameter of the burrow was measured in millimeters, but difficulties encountered in securing a true transverse section of the burrow caused this measurement to be not as accurate as might be desired.

In order to facilitate the handling of data a record sheet was devised.

Sample of Record Sheet

LOCALITY	DATE	SOIL SERIES	DEPTH OF A	TEXTURE OF A	TEXTURE OF B	pH OF A	DEPTH OF BURROW	DIA. OF BURROW	REMARKS
College Station.....	6-8-38	Lufkin	21″	Fine sandy loam	Mottled clay	5.5	9½″	50 mm.	No B in mound
½ mi. S. Bryan.	6-9-38	"	2″	"	"	4.5	—	—	No gophers

To determine the approximate number of pocket gophers on the area, a census method was devised which consisted of strip-counting the *lines* or *groups* of mounds. Each line or restricted group of mounds was considered as indicative of the presence of one gopher. Results obtained were checked with trapping records on a 30 acre tract in a nearby area and with an exact census of a 10-acre tract in Van Zandt County, Texas, where the density of pocket gophers was extremely high.

DISCUSSION

Distribution of gophers in relation to soil types.—Study of the 75 acre tract revealed that, of the four types of soil, pocket gophers occur regularly only in two, Lufkin fine sandy loam and Ochlockonee fine sandy loam. They are entirely absent from the soils of the Wilson series and usually so from the Ochlockonee silt loam. When one considers the nature of the last two soils, the reason for their absence is not difficult to understand. The shallow topsoil (2 inches or less) and the plastic, very sticky and compact subsoil of the Wilson soils are not conducive to burrowing activities. Furthermore, when this soil is dry, it is very compact and hard. Frequent flooding of the Ochlockonee silt loam prevents gophers from permanently inhabiting such areas. When conditions permit, however, they do temporarily extend their burrows into this type of soil; but they are forced to retreat to higher ground at each overflow. Since the sandy topsoil of the Lufkin soils and the fine sandy loam of the Ochlockonee are easily worked, they are ideal for the burrowing activities of pocket gophers. Apparently the only factor operating to curtail the animals' activities in such soils is the depth of the easily worked soil.

Distribution of gophers in relation to depth of soil.—A survey of the two soils (Lufkin and Ochlockonee) in which pocket gophers normally occur revealed that over half the area was unoccupied, particularly in the Lufkin soil. In areas occupied, observations disclosed that in no instance did pocket gophers penetrate into the almost impervious, hard (or sticky, if wet) subsoil. Wherever the topsoil was relatively shallow (6 to 7 inches in depth) the runway of the gopher extended along the top of the B (subsoil) horizon. Testing those areas of the Lufkin soils unoccupied by gophers revealed that although most of the soil appeared suitable from the surface, the depth of the A horizon seldom was over three inches. In fact, it ranged from where the subsoil was entirely exposed to small areas (perhaps pockets) where the topsoil was 10 or more inches deep. These observations led to the question—How deep must the topsoil be before pocket gophers can maintain themselves?

A small tract, about one acre in area, was selected which included areas both occupied and unoccupied by gophers. This tract consisted of the slopes of two small knolls, the intervening depression, and a gully. The area was mapped and the position of each pocket gopher mound plotted thereon. By systematically checking the depth of the A horizon, the fact became established that very few, if any, mounds occurred in places where the top soil was less than 4 inches deep (see fig. 1).

The reason for this is clear when one considers the diameter of the burrow and the fact that pocket gophers, in this area at least, do not extend their burrow systems into the clay subsoil. The average diameter of 40 burrows was determined to be 61 mm., or nearly 2.5 inches. A pocket gopher bur-

rowing in 4 inches of top soil thus would have only 1.5 inches of earth above him. Surely a gopher would encounter difficulty in preventing such a thin roof of his burrow from caving in where the soil is sandy. Apparently it is essential to the welfare of pocket gophers that the burrow system be intact at all times, hence the necessity for burrowing deep enough to overcome the difficulty of caving sand. The average thickness of the roof of 40 burrows

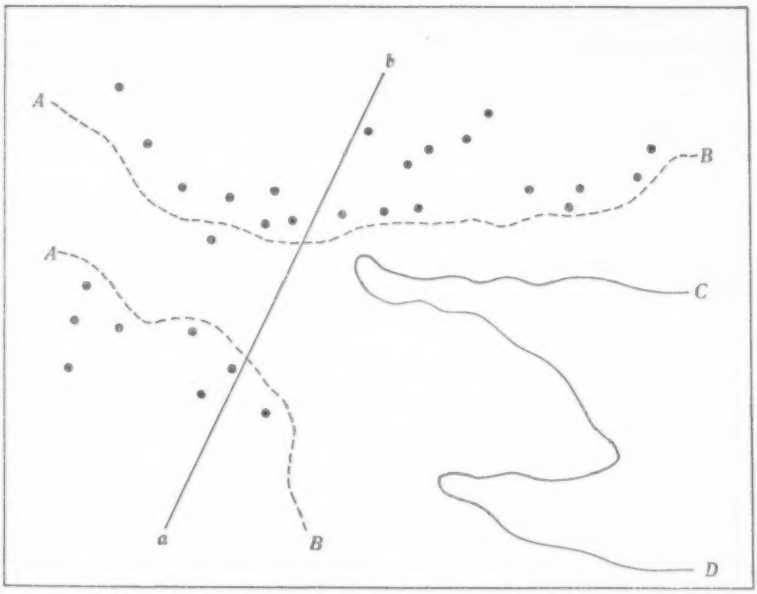

FIG. 1. Surface view of plot showing distribution of pocket gopher mounds in relation to soil depth. Lines A-B indicate the contour lines where the topsoil is 4 inches deep. In the area *between* the two lines the topsoil is from 0 to 4 inches deep. Line C-D outlines a gully approximately 4 feet deep in which the C horizon is exposed. Line a-b indicates the position of the profile diagrammed in fig. 2 (below). Black dots indicate the position of mounds of earth thrown up by pocket gophers. Note that only one mound is in topsoil less than 4 inches deep.

was nearly 5.5 inches, even in areas where the top soil is 24 or more inches in depth. This tendency is illustrated graphically in fig. 2. It should be pointed out, however, that the depth of burrows below the surface varied considerably. The least depth observed was 4 inches (measured to bottom of the burrow); the greatest, 27 inches. The latter paralleled a cut back, not over 6 inches from its perpendicular face.

Not all suitable areas, that is, areas where the top soil was of sufficient

depth to support a burrow system, were occupied by gophers, perhaps because the animals had not found them. This is the explanation offered for the absence of gophers in one good sized plot where soil conditions were suitable, but which was surrounded on all sides by top soil less than 4 inches deep.

Distribution of gophers in relation to pH value of A horizon.—As mentioned above, the pH value of the soil of the A horizon was determined to see if it correlated in any manner with the distribution of pocket gophers. As was anticipated, results indicated no correlation whatsoever. Pocket gophers are just as successful in very acid soil as they are in neutral or basic soils. The range of pH in both occupied and unoccupied soils was from 4.5 to 8.0. Since pH does have a direct relation to plant life, it follows that pocket

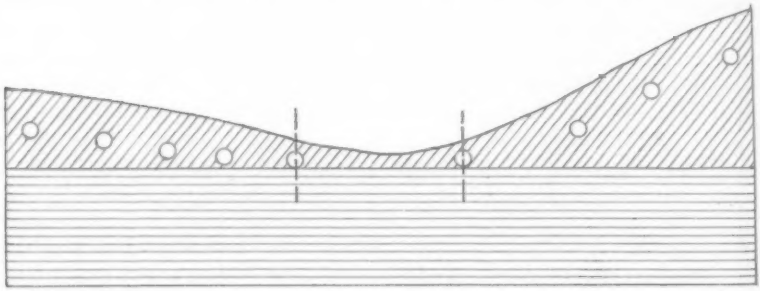

FIG. 2. Diagrammatic sectional profile through line a-b in fig. 1, indicating depth of topsoil and its relation to the subsoil. The two broken vertical lines indicate the position of the 4-inch contour (depth of topsoil) as shown in fig. 1. Open circles indicate cross sections of pocket gopher burrows. Note that no burrows occur in the subsoil; also that the burrows tend to remain at about the same distance below the surface even in deep sandy topsoil.

gophers are not limited in their distribution by the occurrence of a particular kind of plant or group of plants. In fact, as English (Jour. Mamm., 1932, p. 128) pointed out, pocket gophers in the vicinity of College Station eat a great variety of plants.

Density of population.—What is the normal density of pocket gophers in the vicinity of College Station? How numerous do pocket gophers become? Answers to these questions certainly bear on the problems of control.

By means of the census method described above, 51 lines of mounds, hence presumably 51 gophers, occurred on the area in early May, 1938. Since fully half of the 75 acre tract did not support gophers, the density in the area occupied was approximately 1.35 gophers per acre; for the whole tract, .67 gophers per acre. The latter figure compares favorably with the results obtained by Mr. J. L. Stasney on his farm 1.5 miles south of College Station.

He trapped 25 gophers on a 30 acre tract, or a density of .83 gophers per acre. This density appears to be about the average for the Lufkin fine sandy loam near College Station.

Contrasted with the above figures are those obtained by Mr. W. D. Seals, County Agent, from a 10 acre tract of a Norfolk sandy soil in Van Zandt County, Texas. The Norfolk is deep sand and easily worked by gophers. He trapped all the gophers (68) on the area in the spring of 1931, disclosing a density of 6.8 gophers per acre. According to Mr. Seals, this is the highest concentration of gophers he has ever witnessed; mounds literally covered the entire surface of the area. Very few areas support populations of pocket gophers as dense as that disclosed by Mr. Seals' study.

Pocket gophers as indicators.—The practical value of this study lies in the fact that the presence of pocket gophers in a sandy area in East Texas indicates that wherever gopher mounds occur the top soil is 4 or more inches deep; or, conversely, that where mounds are absent the top soil, if sandy, is probably less than 4 inches deep. The absence of mounds from an extensive area of Lufkin fine sandy loam is a fairly good indicator of excessive sheet erosion. Knowledge of this kind might be useful to the land appraisor, to the prospective purchaser of land, or to the soil surveyor.

SUMMARY

1. On the 75 acre tract studied, pocket gophers occur only in soils of the Lufkin and Ochlockonee series, both of which have relatively deep, sandy surface soil. They are absent from the Wilson clay loam and usually from the Ochlockonee silt loam.

2. Pocket gophers (*Geomys breviceps*) require at least 4 inches of sandy top soil in which to burrow, particularly where the subsoil consists of plastic, sticky, impervious clay into which they do not penetrate.

3. Pocket gophers do not occur in the Lufkin soils where the soil of the A horizon is less than 4 inches in depth; absence of pocket gophers from hill sides where the soil is of the Lufkin series probably is a good indicator of excessive sheet erosion.

4. The average depth to which pocket gophers burrow in the vicinity of College Station is 7.84 inches; the average diameter of the burrows is 61 mm. (nearly 2.5 inches).

5. The pH value of the soil is not correlated with the distribution of pocket gophers; these rodents are just as successful in very acid soil as they are in neutral or basic soils.

6. In the area studied pocket gophers never extend their burrows into the clay subsoil; their activities are restricted entirely to the A horizon.

7. The average density on the 75 acre tract was .67 gophers per acre; excluding all non-inhabited areas, the density was 1.35 gophers per acre. These figures are thought to be close to the average for the Lufkin fine sandy

loam in Brazos County. The highest density record available for Texas is 6.8 gophers per acre in deep Norfolk sandy soil.

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NOTES ON THE HOME RANGE AND ECOLOGY OF THE ATTWATER WOOD RAT

By Daniel W. Lay and Rollin H. Baker

In the vicinity of College Station, south central Texas, wood rats (*Neotoma floridana attwateri*) occur in colonies along wooded stream banks. The colony under consideration was located along a sandy gully, 10 to 15 feet deep, which winds 600 feet through dense woodland before emptying into White Creek. Post oak (*Quercus stellata*), winged elm (*Ulmus alata*), hackberry (*Celtis occidentalis*), water oak (*Quercus nigra*), yaupon (*Ilex vomitoria*), rough-leaf dogwood (*Cornus asperifolia*), poison ivy (*Rhus toxicodendron*), stretchberry (*Smilax bona-nox*), and grape (*Vitis* sp.) constitute the important vegetation in this area.

On both banks of the gully distinct trails connected the entrances to the numerous underground dens and led a few feet back from the bank to trees or vines up which the rats habitually climbed to feed. In protected resting spots along these trails, especially under overhanging parts of the gully bank, were piles of dark colored droppings. Four surface dens, consisting of litter piled about the bases of trees or along fallen logs, were found near the gully.

In the fall of 1937 an effort was made to determine the home range of individuals in this colony. Five box traps having a false bottom which functioned to drop the trap door were used at seven trapping stations. Bait consisted of prunes, oat meal, and yaupon berries. The berries proved to be quite satisfactory even though they were abundant on the shrubs surrounding the traps. Distances between the stations were measured and roughly mapped.

Six of the trapping stations were on the west bank of the gully along the main runway. Stations 1, 2, 3, 4, and 5, were located at varying distances down the west bank, the last being 125 feet from the gully outlet into White Creek. Station 6, the only one on the east bank, was located at the end of a fallen log that bridged the gully near Station 3. Station 7 was 100 feet from the place where the gully leaves an open pasture.

Between October 16 and November 16, 1937, 15 rats were marked and released. They were numbered with ear punches made with a baby-chick toe punch. No more than four holes were made in each ear. The code

used for giving a serial number to each rat was 1, 2, 3, or 4 holes in the right ear signifying number 1, 2, 3, or 4. In the left ear 1 hole was 5, 2 holes 10, 3 holes 15, and 4 holes 20. Addition of the numbers in right and left ears gives a possible combination of 24. It is probable that greater refinement of the method of marking would permit a greater series of numbers.

CASE HISTORIES

Rat 1. Male, taken 3 times at station 2 and once at station 4; traveled at least 125 feet down the gully.

Rat 2. Male, taken twice at station 3, and 5 times at station 7; traveled at least 285 feet.

Rat 3. Female, caught 3 times at station 4, once at station 3, 25 feet away, and twice at station 6 across the gully near a log bridge, 35 feet from station 3 and 70 feet from station 4. Thus, the home range may not have been more than 70 feet in diameter. On November 5 this rat was taken from station 6 and released in the edge of the woods 1320 feet away. Three days later it was recaptured at station 3. On November 13 it was carried one-half mile away and released in pasture-land close to White Creek. It was not retaken.

Rat 4. Male, taken at station 6 seven times, including 4 times on successive nights; once at station 3, 35 feet away; once at station 2, 80 feet away. The home range thus indicated was at least 80 feet in diameter. On November 3 this rat was released at the edge of the pasture 600 feet across woodland from station 6. The following night he was retaken at station 6. When released one-half mile away in pasture land, however, he failed to reappear at any of the traps.

Rat 5. Sex not recorded, taken twice at station 1 and twice at station 2, 35 feet away.

Rat 6. Sex not recorded, found dead in the trap at station 6. A large bot fly larva (*Cuterebra* sp.) imbedded in its breast may have contributed to its death.

Rat 7. Large male, caught once at station 6.

Rat 8. Sex not recorded, taken 3 times at station 5. Station 4 was located 65 feet up the gully on the same trail but the rat was not captured there.

Rat 9. Male, marked at station 7 and later killed in a Schuyler rat trap about 100 feet away, near the pasture fence.

Rat 10. Sex not recorded, trapped once at station 2 and once at station 3, indicating a home range of 100 feet. Later it was killed in a Schuyler rat trap near station 2.

Rat 11. Sex not recorded, taken once at station 2 and once at station 7. The intervening distance is 185 feet. This rat was released one-half mile away in pasture land and was not recaptured.

Rat 12. Sex not recorded, trapped 3 times at station 5. On November 5 it was taken 1200 feet across the woods and released at the pasture fence line. It re-entered trap 5 November 16 and was finally taken in a Schuyler trap near station 4, 65 feet away.

Rat 13. Sex not recorded, caught once at station 7; released in the pasture one-half mile away and not recaptured.

Rat 14. Sex not recorded, caught once at station 6; released in the pasture one-half mile away and not recaptured.

Rat 15. Male, appeared once in trap 7.

TERRITORY AND POPULATION DENSITY

Fifteen rats were marked, 8 of which visited more than one station. The average distance traversed between traps by these 8 rats was 108 feet. One rat was trapped three times at one station but it failed to enter another trap 65 feet away. The most complete record of travel is for rat no. 4, a male, which was taken nine times at three stations located on a triangle having a long side of 80 feet. The shortest home range recorded was 35 feet and the longest one 285 feet. Vestal (Jour. Mamm., 1938, vol. 19) found that individuals of the dusky-footed woodrat (*Neotoma fuscipes annectens*) in California bring cuttings from at least as far away from their house as 100 feet.

Three rats returned to their home territory after being transported across woodland 600 feet, 1200 feet, and 1320 feet respectively. Two of them and three others were released one-half mile away in pasture land but none returned. The point of release was about one fourth mile from the border of the home woods. All rats released in woodland, however, returned and there is no indication that the longest distance, one-fourth mile, approached the maximum of the rat's ability to travel in woodland habitat.

A population of from 35 to 50 rats along the 600 foot gully is indicated by trapping records. Since most of the rats lived in dens in the gully bank, the length of the gully was taken as the unit with which to indicate population density. No measurement was made of the distance rats ranged into the woods from the gully bank, but one surface den was about 40 feet from the gully bank. Distinct side trails, branching from the main trail along the bank, led to trees or vines only a few feet from the gully. Before live trapping was begun, 8 wood rats were taken in and near this colony. At the end of live trapping operations, the fate of 6 of the 15 marked rats was known, presumably leaving 9 marked rats in the area. After a delay of three weeks due to wet weather, 25 Schuyler rat traps were set and run daily until no catch was made on 2 consecutive nights. The total catch of 15 included 3 of the 9 ear-marked individuals. By ratio (15:x::3:9) the population, at the end of live-trapping or at the time steel traps were set, appears to have been 45. Adding to this number the 14 rats previously removed from the

area, a total population of 59 is obtained, but the unknown fate of 6 of those marked may indicate that a certain proportion of the population escaped all traps. A check later in December on the runways and den entrances along the gully disclosed few signs of living rats. Three months later 15 traps were set for one night and 3 unmarked rats were taken. These may have moved into the area after trapping operations ceased in December.

ECOLOGICAL NOTES

Habitat relationships.—Thick woodland along stream or gully banks seems to be preferred habitat. But wood rats living in the woodland along the White Creek study area made distinct trails into pasture land where a variety of shrubs and herbaceous plants was available. Sixteen wood rats were trapped at the fence line and in the pasture. In two places they were found living in piles of brush along gulleys in pasture land that had been cleared two years previously. The woody food available to those rats consisted of scattered water oaks and post oaks, stretchberry vines, and yaupon. In addition to the three wood rats, a large number of cotton rats were trapped in these two localities.

Dens.—In the pasture, a female wood rat lived underground in a burrow that might have been made by an armadillo (*Dasypus novemcinctus*). The nest, consisting of one and one-half cubic feet of grass (mostly broomsedge), leaves, twigs, and several half-eaten acorns, was located about three feet from the entrance.

Four surface dens were found in the woodland. These were bulky structures of twigs and litter built about the base of trees or along logs. None was found in trees. One was found in an under-ground burrow, such as is made by armadillos, located in flat terrain fifteen feet from the gully bank. All other wood rats seemed to be using burrows and root crevices in the gully bank. The inner parts of the nests contained grass, shredded grape leaves and bark, yaupon and oak leaves, and other similar materials.

Food.—No stores of food were found, although several partly eaten acorns and many old acorn shells were found in the nests. The sheltered parts of the runways along the gully had several resting places where the rats evidently consumed much of their food. Partly eaten food materials found there disclosed a large proportion of water oak acorns and leaves, and fruit and leaves of yaupon; also many leaves of native pecan (*Carya pecan*), French mulberry (*Callicarpa americana*), stretchberry (*Smilax bona-nox*), peppervine (*Cissus arborea*), trumpet vine (*Campsis radicans*), rattan (*Berchemia scandens*), broadleaf uniola (*Uniola latifolia*), and fruit and leaves of hackberry (*Celtis occidentalis*).

Fighting.—Two female rats, one larger and older than the other, were placed together in a cage. Immediately they began quarreling. Until they were separated fifteen minutes later neither ceased to be on guard in her

respective end of the cage. When on guard they squatted on their hind legs with the fore paws raised and toes clinched, fist-like. The head was raised and held close to the shoulders. The ears alternately were held erect or flat, seemingly to register first alertness and then fear. The vibrissae were directed forward or at right angles to the rostrum (none pointed posterior from its place of attachment) and they quivered nervously from time to time. A low grating noise, seemingly denoting anger, was made several times, accompanied by rapid lateral movements of the lower jaw. In lulls between actual fighting, one or the other of the two rats would thump the floor of the cage with its hind feet. Without lowering the fore feet the rat would raise both hind feet and give the floor a loud rap. Several times this performance was given by both rats, either in unison or alternating. This thumping might be interpreted as a kind of "I dare you."

Actual fighting consisted of rapid jabs to the nose or side of the head made with the fist-like fore feet. The smaller rat was distinctly "right-handed," rarely using the left fore foot; the larger one was ambidextrous. After an exchange of sharp jabs they would close in and make use of their teeth, snapping at the shoulders, ribs, or underside of the neck of the opponent. Usually the one that was "getting the worst" of the fight (frequently the larger one) would break the clinch by rolling over on her back and kicking with all four feet. Both rats soon had bloody nostrils and bare spots in the fur. The larger one, on the defensive most of the time, received a shallow, but freely bleeding, wound on the left side behind the shoulder and a cut hind foot. She took time out, held the wounded left hind foot between her two forefeet and licked it. When released she limped off. The other rat ran away in another direction.

Animal associates.—Two white-footed wood mice (*Peromyscus leucopus* subsp.) were trapped in different places in the wood rat colony. These mice were not numerous, and it is doubtful whether they have any significant relationship to the wood rats. Cotton rats (*Sigmodon hispidus texianus*) range into the woods from the edge of the field. Three were trapped along wood rat trails from 1 to about 10 yards inside the edge of the woodland. Invasion of woodland by cotton rats was not as extensive as invasion of fields by wood rats.

Ectoparasites.—Wood rats were found to be hosts for great numbers of unidentified fleas. At least four specimens were observed to be infested with large bot-fly larva (*Cuterebra* sp.) embedded between the forelegs. Although one of the rats had two large bots over one inch long, together with three smaller ones, located in the pectoral region, it showed no signs of pain or discomfort. Other external parasites were not seen, but the nests examined contained numerous mites. No attempt was made to examine internal parasites.

SUMMARY

1. Results of live-trapping records on 15 Attwater wood rats indicate that these rodents occupy a relatively small home range. One rat, on which the data were most nearly complete, occupied a home range about 80 feet in diameter.

2. Wood rats released in woodland which included their home territory returned from distances as great as 1360 feet. When released in grass land areas one-half mile from their home territory, and one-fourth mile from the woods which included their home territory, they failed to return.

3. A population density of 59 rats along a gully 600 feet in length is indicated by this study; also the fact that the home range of one individual overlaps that of another.

4. In the vicinity of College Station, Attwater wood rats seemingly prefer to construct their dens underground, along cut banks of streams. Only four surface dens (houses) were found.

5. Food, fighting, animal associates, and ectoparasites are discussed.

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MAMMALS OF THE COMMANDER ISLANDS AND THE SURROUNDING SEA

By I. Barabash-Nikiforov

I. NATURAL CONDITIONS OF THE COMMANDER ISLANDS

The Commander Islands, located between 54° 33′ and 55° 22′ North latitude and 165° 40′ and 168° 9′ East longitude, lie at the most western extremity of the Aleutian chain. The archipelago consists of two inhabited islands—Bering Island and Copper Island—and of two small uninhabited islands—Toporkov and Arey islands. Bering Island, the largest of the group, has high mountains in its southern part; its northern part is rather flat with low plateaus and lakes or marshes near sea level. Copper Island, second in size, consists of a continuous mountain range, cut by narrow valleys in which rapid streams flow to the sea. Toporkov Island is a small rocky plateau surrounded by reefs. And lastly Arey Island is simply a small rock rising out of the water.

The climate of the Commander Islands is damp with comparatively mild winters and cool summers; the annual rainfall averages about 725.7 mm. The summer months abound in continuous fog and fine rain. The winds greatly influence all the phenomena of life on the Commander Islands. The north winds are predominant here, their chief characteristic being an extreme

changeableness and from time to time an excessive force (especially in winter). Driven by the winds strong breakers arise on one or the other side of the islands. The sea never freezes near the shore even in the most sheltered places.

As regards the flora, the Commander Islands represent a transition zone between three floral areas: the Manchurian-Japanese, the American-Pacific and the Arctic. The vegetation on the mountains is represented by lichens, mosses and different associations of marshy plants with low grass and dwarf trees (*Betula rana*, *B. ermani*, *Salix arctica*, *S. alaskensis*, *S. reticulata*) spreading their branches over the ground. The vegetation in the valleys is considerably richer. Besides the small plants which like moisture (*Carex glareosa*, *C. podocarpa*, *Equisetum arvense*, *E. hiemale*, *E. pratense*, *Lycopodium annotinum*) very tall umbellifers thrive there (*Heracleum lanatum*, *Coelopleurum gmelini*, etc.).

Zoogeographically the Commander Islands belong to the palearctic faunal area with a small admixture of circumpolar American and North-Pacific forms. The chief characteristic is the extreme poverty in land forms and the great abundance of marine life. There are no amphibians and reptiles on the islands. The invertebrates are represented on land by small numbers of worms (Vermes) and Arthropoda. But on the contrary, the marine invertebrate fauna is rich, being represented by a great variety of molluscs, arthropods, worms (Vermes), coelenterates and echinoderms.

II. LIST OF MAMMALS

Alopex beringensis beringensis Merriam and **A. b. semenovi** Ognev. Arctic Fox.—The first of the above mentioned subspecies lives on Bering Island and the second on the Copper Island. The Copper Island race is distinguished from *A. b. beringensis* by its larger dimensions and darker coloring. There are no essential biological differences between these two subspecies. The predominant color is smoky-gray ("blue"), turning brown in summer. White individuals occur very rarely and they also turn brown in summer. Since it is forbidden to keep dogs on Copper Island, polar foxes come rather freely into the settlement and even raise their young in the basements of buildings. The movements of polar foxes as well as most other phenomena in their lives are chiefly connected with motives of hunger. In their search of food they go against the wind directed by their sense of smell. Considering its manner of life it is very difficult to say whether the polar fox is a day or night animal. It is most probable that the intensity of its activity does not depend on the time of the day, but is rather related to the state of the weather, degree of hunger, and other similar causes.

It seems to be a more or less regular habit of polar foxes to rest at noon on snow drifts or on the grass covering high places. During a violent storm the polar fox, in case it does not go to its hole, usually lies in snow drifts where it is quite covered sometimes with snow.

In winter, when the greatest ebb tides take place, the polar foxes at night time regularly go out on the beaches in search of food. Most often one can hear the barking of polar foxes at night, but nuptial behavior takes place at night as well as in the day. On warm clear days they like to bask in the sun and at the same time the little ones can be seen at the entrances of burrows.

Food.—The chief food of the Commander polar fox consists of marine life, such as

mollusks, echinoderms and crustaceans living on the littoral zone or thrown out by the tides, or the corpses of marine mammals, birds and fish. In summer the polar fox gets eggs from nests in bird colonies and sometimes catches young birds on the sea shore. It also gets some food on the fur seal rookery by scavenging on the dead and eating the placentas. On Bering Island the polar fox also feeds on *Clethrionomys rutilus*.

On the interior of the islands they sometimes eat ptarmigans, which are especially numerous on Bering Island, and from time to time other small birds such as *Plectrophenax nivalis*, mountain finches and others. Besides, on Bering Island, the fish coming into the rivers for spawning play an important rôle in the feeding of the polar fox in summer. In autumn it finds different sorts of berries on the mountain slopes.

The significance of sea-weed as part of the polar fox's food is not clear. It is probably taken accidentally since pieces remain in the stomach unaltered by the digestive juices. Some of the polar foxes feed chiefly on garbage found near human dwellings.

According to the above enumeration of the chief kinds of food, the polar fox obtains its food on the littoral zone, rocks with bird colonies, rivers with spawning fish, the slopes of volcanoes covered with berries, and human dwellings. The percentages of kinds of food found by us in 296 stomachs and in the excrement of polar foxes on Copper Island are represented in table I.

Moult.—The time of moulting depends on climatic conditions, the age of the animal and its physical condition as well as other factors. As far as it is possible to judge from

TABLE I

Ratios of kinds of food of the polar fox on Copper Island

SEA MAMMALS	BIRDS	FISHES	SEA URCHINS	MOLLUSCS	HOLOTHURIANS, ASCIDIANS, SPONGES, WORMS	CRUSTACEANS	INSECTS	VEGETABLE REMAINS	GARBAGE FROM HUMAN DWELLINGS
6.8	39.5	14.9	30.1	23.0	16.2	25.0	0.7	14.5	13.5

observations based on Commander polar foxes, both the weather and the amount of available food greatly influence the course of this process. The first sign that the moult has commenced in the Commander polar foxes is when the fur becomes brown or reddish, a fading that depends on alterations in the hair pigment. It begins either in February or in some cases at the end of January. The actual falling out of the hair usually begins at the back of the head and withers and spreads on the sides. By the end of August most of the polar foxes have very little faded old hair left except on the tail. Their body is now the normal "blue" color. The moult is fully over by the end of September, and at that time most of polar foxes have acquired the usual winter coat.

Reproduction.—The first signs of the beginning of the mating period of polar foxes are observed in the second half of January. Pairing begins in February and it is accompanied by fighting among the males. During these savage fights between rival males the reproductive organs are very often injured. Immediately after mating the adult polar foxes begin to settle in their homes, but the young pairs, however, as we have often seen, do not always select a home at once. The females bring forth their young under the open sky and then run around in search of a home, sometimes carrying their young from place to place. Parturition chiefly occurs in May or June, earlier or later, according to the time of mating. The duration of pregnancy averages 52 days. The number of pups in a litter, as the old records show, did not exceed a maximum of 12 pups. Out of 17 litters counted on Copper Island in the period 1931–1933, five litters

consisted of 6 pups, six of 7, three of 5, one of 10, one of 8, and one of 4, the average being 6.4 to a litter.

The male and female take part in the care of the young, the male providing most of the food for the whole family. After the young leave the burrow (for the first time) the parents take them to a temporary shelter under the rocks on the shore. Living quite near the chief source of their food the young polar foxes little by little learn to get their own food. By August or September the care and attachment of the parents to their young begins to diminish; frequently fights for food occur between the members of one family and by the end of September the family is disrupted.

The Building of Burrows.—The construction of the burrows depends on the soil, those in soft ground having long and sometimes rather deep passages. In rocky ground the arrangement of the passages and their extent depend on the position of such obstructions as large stones. The burrows are also adjusted to natural cavities among the rocks.

At the end of the burrow there may be either a nest for the young or a temporary shelter for a single fox during bad weather. Burrows that lead to a nest are usually built in soft soil and have a rather complex construction. The temporary burrows, on

TABLE II

The results of the examination of 25 stomachs of Callorhinus from Copper Island

CONTENTS	IN HOW MANY STOMACHS	NUMBER FISHES IN 1 STOMACH
Gadus macrocephalus	8	1–3
Theragra chalcogramma	5	2–5
Hexagrammos sp.	3	5–8
Pleurogrammus monopterygius	4	4–10
Myoxocephalus sp.	2	1
Polypus sp.	2	1–2
Small stones	6	2–5
A piece of towline	1	1

the contrary, are usually made among rocks; those in soft soil are much simpler than the nesting burrows. All burrows are usually dug near a source of food.

Enemies and Rivals.—There appear to be no enemies of adult polar foxes on Bering Island except dogs. Several observations indicate that the white owl and the raven may be considered as enemies of young polar foxes, and as rivals of adult polar foxes. The white owl is doubtless a rival of the polar fox on Bering Island because it also feeds on *Clethrionomys rutilus*. The raven secures the same food from the littoral zone as the polar fox. Sea-gulls likewise compete for the same food but are not important.

Diseases and Mortality.—The endoparasites such as cestodes, trematodes, nematodes have a very harmful influence. Cestodes and trematodes predominate in the polar foxes on Bering Island and nematodes in the polar foxes on the Copper Island. Polar foxes feeding near human dwellings appear to be mostly infected with endoparasites.

Enhydra lutris Linnaeus. Sea Otter.—Most abundant around Copper Island. The biology of this animal has been described in my article "The Sea Otters of the Commander Islands" (Jour. Mamm., vol. 16, no. 4, pp. 255–261, 1935).

Callorhinus ursinus Linnaeus. Fur Seal.—The animals spend only the summer period on the Commander Islands. They begin to arrive at the end of April or the beginning of May but are present in their greatest numbers at the beginning of August. The first new-born young appear in the middle of June, 2 to 3 days after their mothers

arrive at the island. Soon after this the fertilization of mothers occurs. Moulting takes place from the middle of August until the middle of September, and about the middle of October the animals begin to leave the island. Fish is the chief food of the fur seal as the table II shows.

The killer whale (*Orcinus orca*) is doubtless an enemy. The polar foxes eat the bodies of dead fur seals, and attack young weakened by sickness.

Infection with endoparasites, chiefly *Uncinaria*, is especially great among the young fur seals. Of ectoparasites, I have found *Echinophthirius fluctus* Ferris on the body of a fur seal.

Eumetopias jubata Schreber. Sea Lion.—Near the Commander Islands sea lions, almost exclusively males, occur only in the winter period from October until April. From the beginning of April they gradually disappear and probably migrate to the east coast of Kamchatka. One cannot find their young on the Commander Islands, but on Bering Island in April, 1932, a female sea lion with an embryo 655 mm in length was killed. This is the only known record. In summer only solitary young male sea lions live near the islands. On Copper Island these males often associate with the fur seals. As far as the stomach contents show, the chief food of the sea lion consists of fish. In the stomachs of those taken during early spring (March–April) about 25 fishes were found, including *Cyclopterichthys ventricosus* Pallas, *Gadus macrocephalus* or *Theragra chalcogramma*, single specimens of *Hexagrammidae* and *Pleuronectidae*, as well as a few scraps of a small *Polypus*. In the stomach of a June specimen about 5 *Hexagrammidae* were found.

Phoca vitulina largha Pallas. Hair Seal.—This seal is found near the Commander Islands the whole year. Parturition takes place at the end of April or at the beginning of May. The duration of pregnancy is about 2 months. This seal preys chiefly on organisms found at the bottom of the sea. The stomachs of seals taken in winter and early spring contain chiefly mollusks (small *Polypus*), crabs, *Phascolosoma* sp., and so on. Some small Crustacea such as *Grammarus* sp. may be added to the latter. Sometimes sea-weeds are found among the stomach contents. This indicates that fish are only a secondary item in the food. In those places where *Cyclopterichthys ventricosus* comes to the shore, it may be found in the stomach contents. Traces of *Cottidae* and *Hexagrammidae* may also be found in the stomachs. A considerable percentage of stomachs are devoid of any contents.

Phoca hispida subsp. Rough or Ringed Seal.—Solitary individuals appear near the islands in spring. During summer they are rarely seen, and in winter they seem to be entirely absent. Judging from the stomach contents of seals taken on the Commander Islands their food seems to be rather varied. In two of the stomachs were found fish (*Hexagrammidae*) as well as crustacea (crab) and a small octopus (*Polypus*).

Erignathus barbatus nauticus Pallas. Bearded Seal.—This seal rarely occurs near the Commander Islands.

Histriophoca fasciata Zimmerman. Ribbon Seal.—This is also a rare visitor.

Odobenus rosmarus divergens Illiger. Walrus.—Formerly walruses regularly visited the Commander Islands. The last record of walruses being caught on Bering Island was at the beginning of the 20th century. From time to time dead carcases of walruses are thrown ashore, evidently brought here by the current from the northern part of Bering Sea.

Rattus norvegicus Erxleben. Norway Rat.—Common in the settlements on Bering and Copper islands. In the year 1931 I got on Copper Island one specimen with a rather peculiar elongated skull. I did not have sufficient material to determine what geographic race it represented. It is quite possible, indeed, that other kinds of rats have been brought to the islands along with freight.

Mus musculus Linnaeus. House Mouse.—It was brought for the first time to the islands in the year 1870 with a cargo of flour (Stejneger, 1883, p. 88). Now it occurs chiefly in the settlement on the Bering Island. A few of these mice have been observed on Copper Island, but for some reason the species does not find suitable conditions there.

Clethrionomys rutilus Pallas. Red-backed Mouse.—According to data that we have, this rodent was brought rather late in the 19th century along with firewood from Kamchatka to Bering Island (Stejneger, 1883, p. 88). At the present time it has multiplied on this island but does not occur on the other islands. It occurs in various places including inhabited buildings, where it is as harmful as house mice. It feeds on branches and catkins of dwarf birch trees and willows and on grass seed. Dissection shows that almost 50 per cent of these animals are infested with an intermediate stage of *Taenia echynococcus*.

Balaenoptera physalus Linnaeus. Finback.—This is the commonest whale near the Commander Islands. Although present throughout the year, it is most abundant in spring, summer and autumn, when it sometimes occurs in rather large herds. This whale feeds on plankton (Schizopoda) and on small fish.

Balaenoptera borealis Lesson. Sei Whale.—In 1931 while crossing the strait between Bering and Copper islands on a cutter, I twice observed these animals in small groups.

Megaptera nodosa (Bonnaterre). Humpback.—Single wandering individuals occur more or less often near the Commander Islands.

Rhachianectes glaucus (Cope). Gray Whale.—This whale visits the islands, but not regularly, and then in fairly large herds. It feeds on bottom invertebrates and possibly on small fish.

Physeter catodon Linnaeus. Sperm Whale.—Males only appear near the Commander Islands area during migration. They feed mostly on octopus.

Berardius bairdii Stejneger. Baird's Beaked Whale.—This whale as well as other kinds of the family Ziphiidae are inhabitants of the waters surrounding Commander Islands. They often form rather large schools and feed mostly on mollusks (Cephalopoda) and to a lesser extent on fish. Besides the above Grebnitsky and Stejneger (1883) have recorded the existence near the Commander Islands of *Ziphius cavirostris* and *Mesoplodon stejnegeri*.

Orcinus orca (Linnaeus). Killer Whale.—This rapacious whale is also a conspicuous member of the sea fauna of the Commander Islands. Killers appear in small numbers in the spring and are present in small herds, as many as 20-25 individuals, near the islands. In summer their numbers diminish but in autumn they appear again in greater numbers. In winter solitary individuals have been seen. They feed on fish, and sometimes attack seals and, as some observations show, sea otters.

Delphinidae. Porpoises.—Small forms such as *Delphinus*, *Phocaena*, *Lagenorhynchus* are usually to be met in small herds in summer. I can not identify the forms I have observed for want of material.

Rangifer tarandus Linnaeus. Reindeer.—During the year 1882, reindeer were introduced on Bering Island. By 1896, the original stock of 15 had multiplied so rapidly that the herd was estimated to comprise between 600 and 1000 reindeer (Stejneger, 1896, p. 33).

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NOTES ON THE MAMMALS OF SOUTHERN LABRADOR

BY C. F. JACKSON

The vast area of the Labrador has been explored by numerous scientific expeditions, and the larger mammals and their geographical ranges are fairly well known. Most of this work has been done along the Atlantic coast from the Straits of Belle Isle northward through Ungava Bay to Hudson Straits and along the eastern side of Hudson Bay into James Bay. However, little is known of the small mammals of this region, although there have been permanent settlements on the south shore of the Labrador since early in the sixteenth century (Low, 1895).

The small mammal population of the section of coast line from the Bay of Seven Islands eastward for a distance of several hundred miles, approaching the Straits of Belle Isle, is almost unknown. All of this region lies within the Hudsonian Zone, the line between the Hudsonian and Canadian zones extending in general from the southern end of James Bay on Hudson Bay eastward to the region of Shelter Bay on the Gulf of the St. Lawrence (Anderson, 1934).

Work on the small mammals of Labrador has been carried on at widely scattered points and the making of collections in many cases has been incidental to some other type of work. In the Merriam collection of the National Museum at Washington are a considerable number of mammals from Godbout, taken over a period of years. This locality, however, is far south of the region under consideration and well within the Canadian Zone. To the eastward, beyond the Straits of Belle Isle, Ernest Doane spent some time collecting specimens for the Bangs collection (Bangs, 1899) which is now deposited in the Museum of Comparative Zoology. These specimens, however, are from the eastern fringe of the Hudsonian Zone, or from within the Arctic Zone, which extends to the southward from the Arctic Circle along the Atlantic seaboard as far as Newfoundland (Anderson, 1934). According to

Dr. Harrison F. Lewis, there are about 50 specimens from southern Labrador in the National Museum at Ottawa, Canada. J. Kenneth Doutt has kindly informed me of a large collection of mammals in the Carnegie Museum at Pittsburgh, which, however, has not been thoroughly worked over.

Dr. R. A. Johnson, State Normal School, Oneonta, New York, while working with Dr. Lewis, 1930–1934, on the birds of southern Labrador, made a small collection of mammals, some of which have been deposited in the collection of the Roosevelt Wild Life Station, Syracuse, New York. This collection was made in the vicinity of Mingan and eastward. Dr. Johnson has kindly allowed me to refer to his field notes and has also furnished me with considerable material in the form of owl pellets containing skulls and teeth of *Microtus*.

Numerous papers have been published giving lists of the mammals of Labrador, such as those by Robert Bell (quoted by Low, 1895), A. P. Low (1895), and Outram Bangs (1898, 1899); but these papers deal mainly with the distribution of mammals of the north, east, and Hudson Bay coasts. A most excellent paper has been published by Dr. R. M. Anderson (1934) on mammals of the eastern Arctic and Hudson Bay, which refers to many forms found on the south shore of Labrador and gives an excellent bibliography. In 1935, Dr. Eidmann published a paper on the mammals of southern Labrador in which he listed ten species that he collected and several others observed. This is the most recent contribution, and is the result of personal observations. The work was limited, however, to the region of Matamek at the head of Moisie Bay.

The work here treated is the result of two trips made to the region from the Bay of Seven Islands eastward to near Cape Cormorant. The first trip was made in the fall of 1935, and included, in addition to the region around Seven Islands, Boule Bay, and Moisie Bay, a trip up the Moisie River to the falls, and a collecting station on the opposite side of Moisie Bay at Seal House Cove. The 1937 expedition was much more successful in regard to the number of specimens collected. The field work was done by Robert Eadie, instructor in comparative anatomy at the University of New Hampshire, and Herbert W. Jackson of the Zoology Department of Cornell University. About 200 specimens of small mammals were taken, chiefly from the following six stations: three miles below the falls on the Moisie River; near the mouth of the Moisie River; Seal House Cove; St. Charles Point; Seal River; and Pigou River. Travel was by canoe and during the last trip there was a total of roughly 2000 trap nights.

The majority of the country over which collecting was done is composed of rocky hillsides covered with a dense growth of lichens, and various mosses, and interspersed with shrubs that in some places formed a mat through which it was difficult to walk. A growth of small timber, chiefly black spruce and birch, occurred in the ravines. Swamps of a greater or lesser extent, together

with sphagnum bogs, were also encountered at most of the stations. Some of the trapping was done along the sandy flats bordering the Moisie River, as well as in the region just back from high tide line.

Some genera, such as *Peromyscus*, *Clethrionomys*, *Microtus*, and *Sorex* were widely distributed in practically all of the different types of environment. *Zapus* was much more restricted in its habitat. The other species collected were taken in numbers too small to afford evidence as to their typical habitat.

The author wishes to express his appreciation to Dr. H. H. T. Jackson and other workers in the Biological Survey and the National Museum, Washington, D. C., for the privilege of using specimens under their charge for comparison. Also to Dr. H. E. Anthony and Dr. John Eric Hill of the American Museum, New York, for assistance in classification, and especially to Dr. Glover M. Allen of the Museum of Comparative Zoology, Harvard University, for the privilege of comparing specimens with those in the Bangs collection from Black Bay and Hamilton Inlet. Also this expedition would have been impossible except for the help of my two assistants, W. R. Eadie and H. W. Jackson, who, as noted above, did the field work and actual collecting.

The following is an annoted list of species actually encountered or taken on the 1935 and 1937 trips to southern Labrador, from the region of the Bay of Seven Islands eastward to near Cape Cormorant.

Condylura cristata (Linnaeus). Star-nosed Mole.—One adult male was taken September 4, 1937, at the mouth of Pigou River that is apparently typical for the species except that there are only 10 fleshy protuberances of the nose, with the median ventral pair very short. In the typical form there are 11 pairs. Measurements are 196, 86, 30 mm. Tunnels thought to have been made by this mole were observed at several other stations. The finding of this species was not surprising, since it has been taken at Hamilton Inlet to the eastward and at James Bay, several hundred miles to the westward, as well as throughout southern Quebec.

Sorex cinereus miscix Bangs. Labrador Long-tailed Shrew.—Twenty-six specimens of this subspecies were taken. No other mammal was found so widely distributed, as it was taken from every conceivable habitat. This subspecies was noted by Jackson (1928), Anderson (1934), and Eidmann (1935), as occurring only along the Atlantic seaboard to the eastward. However, we found our series of specimens to coincide point by point with Jackson's description of *Sorex cinereus miscix*. The probability is, however, that this is an intermediate region.

Sorex arcticus laricorum Jackson. Southern Saddle-back Shrew.—Three specimens of saddle-back shrew were collected along the west bank of the Moisie River. All skull measurements corresponded to those of this race except that of condylobasal length, which was slightly larger. Measurements were distinctly larger than those for *Sorex arcticus arcticus* as given by Jackson (1928). However, the summer color pelage is indistinguishable from specimens in the Biological Survey from the range of typical *arcticus*. The largest specimen had a total length of 122 mm. and correspondingly greater skull measurements. This, and the fact that *Sorex arcticus laricorum* has previously been reported only from west of the Great Lakes, leaves considerable doubt in my mind as to the taxonomic position of these shrews. So far as I am aware, this is the first time the saddle-back shrew has been found in Labrador.

Sorex palustris gloveralleni (Jackson). Nova Scotia Water Shrew.—The water shrew

is not mentioned by either Eidmann (1935) or Anderson (1934) as occurring in Labrador. It was, however, noted by Anthony as extending to Labrador. Two specimens were taken, one at Point St. Charles, and another at Seal River. There is some question as to the subspecies to which these should be assigned. The white-lipped water shrew, *Sorex palustris albibarbis*, has been reported from Lake Edward, Godbout, and other points in Quebec; but these two specimens do not belong here since the tail is bicolored all the way to the end and the underparts are white or light gray as in the Nova Scotia form. They seem to belong to the latter race, except that the Point St. Charles specimen is much larger than typical, measuring 174 mm. in length.

Microsorex hoyi intervectus Jackson. Northern Pigmy Shrew.—Specimens of this shrew have previously been taken at Godbout and Fort Chimo. We took one specimen from Point St. Charles, which is within the expected range. Measurements were typical.

Mustela cicognanii cicognanii Bonaparte. Bonaparte Weasel.—One specimen of this weasel was taken in a thick stand of black spruce near the mouth of Seal Harbor, September 1. Another very similar specimen was taken on an earlier trip at the Poulette Lakes just east of the Saguenay River. No marked differences could be noted in the two. Dr. Eidmann (1935) reported taking one near the mouth of the Matamek River.

Vulpes rubricosa bangsi Merriam. Labrador Red Fox.—Foxes were reported as very abundant throughout this region in 1935. One specimen, probably of this race, was observed at close range on the banks of the Moisie. Tracks and signs were everywhere abundant. In 1937 none were observed and very few signs were in evidence, perhaps in correlation with the low rabbit population. According to both Anderson (1934) and Eidmann (1935), there is some doubt as to the race of fox occuring along this coast. I am, therefore, following Dr. Anderson's opinion.

Phoca vitulina concolor DeKay. Atlantic Harbor Seal.—Harbor seals were not abundant. Several were observed at the mouth of the Moise River, however, and during the 1935 trip seals were encountered nearly to the falls. One or more were seen in most of the harbors visited, on both trips, but no specimens were taken.

Sciurus hudsonicus hudsonicus Erxleben. Northern Red Squirrel.—One specimen of the nortnern red squirrel was taken at Pigou Harbor, September 5, 1937. Individuals were noted at all of the collecting stations, but they were particularly abundant along the high spruce-covered bluffs of the Moisie River. They seemed to be extremely suspicious, both of traps and of people, although those of the Matamek region were reported otherwise by Dr. Eidmann.

Peromyscus maniculatus subsp. White-footed Mouse.—The white-footed mouse of Labrador was everywhere abundant and was taken at all collecting stations. It seemed to be the most abundant mammal along the Labrador coast, in numbers closely approached only by *Microtus* and *Clethrionomys*. A total of 67 specimens were taken, out of about 200 of all species secured. Our notes show that they were taken from practically every habitat. The only exception was in very damp localities, where, on the other hand, *Microtus* frequently occurred.

According to Dr. Eidmann (1935), this region is inhabited by a group of *Peromyscus* intermediate between *P. m. maniculatus* and *P. m. gracilis*. In his opinion the range of the former extends from Cape Chidley south along the Atlantic seaboard past the Straits of Belle Isle, and westward to about Cape Cormorant, thence inland in a broad band to south of James Bay. The intermediate group extends from Cape Cormorant along the shore line as far as Pointe des Monts and westward inland. Specimens collected on an earlier trip at the Poulette Lakes east of the Saguenay seem to be the same as those taken from the northern part of New Hampshire (*P. m. gracilis*), which would agree with the distribution suggested by Dr. Eidmann.

It is interesting to note that Ernest Doane, collecting for Outram Bangs (1899), apparently failed to take this species at Black Bay, Straits of Belle Isle, as it is not mentioned in Bangs' paper on that region. Bangs (1898) wrote that he had examined only a few specimens from Labrador where he regarded the species as quite rare. This might mean that the mice were abundant only locally or in certain cycles, although we found them everywhere abundant in 1935 as in 1937. Johnson apparently found the species rare to the eastward, as he mentioned taking only two specimens.

Whether or not the *Peromyscus* of the Moisie region should be classified as of the subspecies *maniculatus* or *gracilis*, specimens differ considerably from those taken farther south; nor are they similar to material from the east coast. In fact, they more closely resemble *Peromyscus maniculatus abietorum* from Nova Scotia than either of the above groups. Further study will be necessary before their taxonomic position can be fixed.

Phenacomys ungava ungava Merriam. Ungava Phenacomys.—Specimens of this *Phenacomys* have been taken both at Fort Chimo and at Godbout, but the species is extremely rare in collections. Three specimens were taken, two from Point St. Charles, and one from Seal River. Two were relatively immature. The mature specimen from Point St. Charles was in very bad condition and was thickly covered with mites. It contained six embryos (August 24). The specimens were allocated to this subspecies rather than to *P. u. crassus*, which lies to the eastward, largely because of the measurements and a comparison with specimens of *crassus* in the Bangs collection.

Clethrionomys gapperi proteus Bangs. Labrador Red-backed Mouse.—This is one of the most numerous species encountered. It was taken in all suitable habitats at every station. More than 40 specimens were collected. Among these were only two of the black or melanistic phase. This fact is of interest since among the specimens taken at Black Bay by Ernest Doane, and deposited in the Bangs collection (Bangs, 1899), the dark phase predominates. Specimens were very similar to those in the Bangs collection and measurements and color were typical of this subspecies. Dr. Eidmann took one specimen of this species at Trout Lake.

Microtus pennsylvanicus fontigenus Bangs. Forest Meadow Mouse.—This subspecies of *Microtus* was only slightly less numerous than *Peromyscus* or *Clethrionomys*. A total of 24 specimens were taken, some from every trapping station. There were many young or half-grown individuals. This species occurred in all types of environment within wooded areas. A few of the females were nursing.

Sixty-eight owl pellets collected in the vicinity of Cape Whittle were kindly sent to me by Dr. R. A. Johnson. Of these, 7 contained no remains of mice. Of the remaining 61, 55 included the skulls and teeth of this species. A total of 94 skulls were definitely identified as those of *Microtus*. No other mice remains were present. This would seem to indicate that in 1934, when these specimens were collected, neither *Peromyscus* nor *Clethrionomys* was as abundant as *Microtus*.

Dr. Eidmann (1935) placed in this subspecies a *Microtus* that he collected in September from the mouth of the Matamek River.

Microtus chrotorrhinus chrotorrhinus Miller. Rock Vole.—Only two specimens of this vole were taken, one on the Moisie and one at Seal River. They were probably distributed throughout the region, however. The species is undoubtedly of this race rather than *M. c. ravus*. This decision is based on Bailey's (1900) description and also on a comparison with specimens of *ravus* from the Black Bay region in the Bangs collection.

Zapus hudsonius ladas Bangs. Labrador Jumping Mouse.—Six specimens were taken at several different collecting stations. It seems to be a widely distributed mouse but is nowhere abundant, and is always found in association with small patches of grass.

The specimens seem to be more closely related to the race *ladas* than to *Z. h. hudsonius*, although they were placed in the former subspecies largely on geographical grounds. Specimens of this subspecies have been taken at Hamilton Inlet, Black Bay, Godbout, and Trout Lake at the head of Moisie Bay. A comparison of our specimens with specimens taken from northern New England, however, shows very little difference.

Napaeozapus insignis abietorum Preble. Northern Woodland Jumping Mouse.—Only a single specimen of the northern woodland jumping mouse was taken, this being on the banks of the Moisie. Specimens from this region are also in the National Museum of Canada.

Lepus americanus americanus Erxleben. Snowshoe Hare.—The snowshoe hare is supposed to be more or less abundant along the southern Labrador coast. It has, however, been very scarce during both of my collecting trips. Parts of two specimens, presumably killed by either owls or foxes, were found, but no specimens were taken.

Rangifer caribou caribou Gmelin. Woodland Caribou.—Tracks of caribou were seen at several points, particularly in the region of Pigou. Also portions of the skull and cervical vertebrae were found on the Moisie River. No living animals were seen.

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THE MAMMALS OF VERMONT

By Frederick L. Osgood, Jr.

Published lists of Vermont mammals are few in number. Zadock Thompson's "History of Vermont," published at Burlington 1842, recorded 43 species. Of these the wolverine, wolf, and elk are extinct. John W. Titcomb's "Animal Life in Vermont" (1901), listed 48 species including the elk and wolf.

George H. Perkins in The Report of the State Geologist (1909–1910) listed 48 species preserved in the State Cabinet; elk, wolf and woodland caribou were included. He also listed and described the fossil mammals so far found in the state. Parts of elephant from Mt. Holly, Bellows Falls, and Richmond were described and a fossil whale from Charlotte was figured.

George L. Kirk's "The Mammals of Vermont" (1916), listed 55 species based on collections and observations made between the years 1912 and 1916 by Kirk and Duane E. Kent.

The present list is based on field work, investigations of unusual species, and collections made from 1916 to 1938. The list includes 61 mammals.

LIFE ZONES

Two well-marked life zones occur in Vermont, the Canadian and the Transition. The dividing line between the two zones seems to be at about 1200 feet altitude, but there is more or less overlapping. Canadian Zone islands also are found in cool swamps. The Canadian Zone plant indicators are: red spruce, *Picea rubra;* balsam fir, *Abies balsamea*; mountain maple, *Acer spicatum*; striped maple, *Acer pennsylvanicum;* mountain ash, *Sorbus americana;* hobblebush, *Viburnum alnifolium;* bunchberry, *Cornus canadensis;* painted trillium, *Trillium undulatum;* mountain goldenrod, *Solidago macrophylla;* avens, *Geum macrophyllum.*

The following are Transition Zone plant indicators: white pine, *Pinus strobus;* basswood, *Tilia americana;* elm, *Ulmus americana;* butternut, *Juglans cinerea;* hickory, *Carya alba;* silky cornel, *Cornus amomum;* sweetfern, *Comptonia asplenifolia;* frost grape, *Vitis vulpina;* downy goldenrod, *Solidago puberula;* fringed polygala, *Polygala paucifolia;* American columbine, *Aquilegia canadensis.*

The Transition Zone occupies less than 25 percent of the area of the State and is confined to the Champlain Valley, the valleys of the larger river and creek systems, and the foothills of the Green Mountains in the southern part of the state. The Taconics, at the south end of the Champlain Valley, are largely Transition.

LIST OF SPECIES

Didelphis virginiana virginiana Kerr. Virginia Opossum.—At least five have been taken in Vermont. Kirk (1921) recorded the first from Dorset and the second (1922) from Rochester. The third, taken at Bridgewater, November 21, 1933, was exhibited at Rutland in the flesh. The fourth was trapped at Tinmouth by a Mr. Gilman and secured for the collection by L. Henry Potter. The fifth, killed in a henhouse at Windham, February 23, 1936, was recorded in the local press. All were large males.

Parascalops breweri (Bachman). Hairy-tailed Mole.—Occurs in fields and woods; prefers drier soil than the star-nosed mole. Most common at higher altitudes but not confined to them. Collected in Rutland, Windham, and Essex counties.

Condylura cristata (Linneaus). Star-nosed Mole.—Abundant in moist meadows and borders of marshes and streams. Occasionally taken in same tunnel with *Parascalops breweri*. Collected at 1950 feet altitude at Sherburne. Taken in Rutland and Windham counties.

Sorex cinereus cinereus Kerr. Cinereous Shrew.—Common in woods. Collected in Rutland and Essex counties. Seems to be entirely absent from eastern Windham County.

Sorex fumeus fumeus Miller. Smoky Shrew.—Occasionaly in cool, mossy woods and in sphagnum bogs. This species was first recorded from Vermont (Mt. Mansfield) by A. H. Howell in 1901. Collected also in Rutland County.

Sorex fumeus umbrosus Jackson. Northern Smoky Shrew.—Two taken at Brighton August 3, 1936, by Robert G. Chaffee and F. L. Osgood. One taken at St. Albans, June 21, 1937, by G. L. Kirk (Champlain Valley). The St. Albans specimen was checked by H. H. T. Jackson.

Sorex dispar Batchelder. Gray Long-tailed Shrew.—Found in mountains, rare. First record G. M. Allen, 1913. Collected at Wallingford, Rutland, and Sherburne.

Sorex palustris albibarbis (Cope). White-lipped Water Shrew.—Occasional along mountain streams. First recorded from Vermont by Kirk (1916). Collected in Rutland and Essex counties.

Microsorex hoyi thompsoni (Baird). Thompson Pygmy Shrew.—Only two Vermont records: Zadock Thompson, Burlington, 1842; Robert Chaffee and F. L. Osgood, Brighton, August 3, 1936. The Brighton specimen contained six 1 mm. embryos (2 R, 4 L). W. J. Hamilton, Jr. identified the stomach contents as, "several fragmentary small grubs, a segment or two from a small earthworm and several chitinous parts from an undetermined insect, quite probably a beetle."

Blarina brevicauda talpoides (Gapper). Large Short-tailed Shrew.—Abundant throughout the state. Taken at all altitudes.

Myotis lucifugus lucifugus (LeConte). Little Brown Bat.—Abundant in summer roosts and a few found wintering in caves. These bats congregate in thousands around buildings. In winter they migrate south, as is amply proven by the bat banding carried on by Donald R. Griffin. Taken at Castleton, Bellows Falls, Rutland, Clarendon, Brandon, and present all over the state at not too high altitudes during the summer.

Myotis keenii septentrionalis (Troussart). Eastern Long-eared Bat.—Occasional throughout the state in summer; very rare in caves in winter; migrates south in fall. Collected at Brighton, Rockingham, Dorset, and Plymouth.

Myotis sodalis Miller and Allen. Pink Bat.—Common in winter in caves. Collected at Brandon, Dorset, and Plymouth. Very few summer records. Two specimens examined at Castleton and Rutland in summer but skins not preserved.

Myotis subulatus leibii (Audubon and Bachman). Least Brown Bat.—First recorded by Kirk (1916) from Chittenden. Collected by D. R. Mahaffy for Kirk and described by E. W. Nelson (Proc. Biol. Soc. Washington, vol. 26, p. 183) under the name *Myotis winnemana*. Collected at Brandon, West Haven, Dorset, and Plymouth.

Lasionycteris noctivagans (LeConte). Silver-haired Bat.—One of the common bats in summer. Collected at Rutland; observed at Rockingham and Castleton. Migrates south in fall.

Pipistrellus subflavus obscurus Miller.—New York Pipistrelle. A few winter in caves, more numerous in summer. Reaches its northern limit in New England. Earl L. Poole has checked a number of skins from Vermont and places them in this subspecies. Two melanistic specimens have been collected. Collected at Brandon, Rutland, Dorset, and observed at Rockingham.

Eptesicus fuscus fuscus (Beauvois). Large Brown Bat.—Common in Transition

Zone in summer; sometimes winters in caves at the lower altitudes; reaches Rockingham about May 15. Collected at Rutland, Rockingham, Mendon, West Haven, and Brandon.

Lasiurus borealis borealis (Müller). Northern Red Bat.—Occasional at all altitudes during summer. Migrates in winter. Collected at Wallingford, Rutland, Mendon and Castleton.

Lasiurus cinereus (Beauvois). Hoary Bat.—Rare; collected by Thompson at Burlington (Colchester), soon after 1840. Thompson wrote of one kept in a clothes hamper that ate raw meat. Collected by Carl Pember at Woodstock, 1921 (G. L. Kirk collection). Sight records at Sherburne.

Euarctos americanus americanus (Pallas). Black Bear.—Occasional in forested areas. Not protected by law but holding its own against man. The Fish and Game Service reports 26 killed during the hunting season of 1936.

Procyon lotor lotor (Linnaeus). Eastern Raccoon.—Common in deciduous woods about lakes and streams. The Fish and Game Service reports about 15,000 taken during the season of 1936.

Martes americana americana (Turton). American Marten.—Once common in higher spruce-covered mountain ridges, now nearly extinct. Kirk (1916) reports it from Chittenden, 1900 and Glastenbury, 1915. While on a trip with a fur buyer, I purchased from a trapper one that had been shot by a deer hunter on Stratton Mt., November, 1926. It was pale in color and two toes were missing from the right front foot.

Martes pennanti pennanti (Erxleben). Fisher.—This valuable furbearer is nearly extinct. Kirk records tracks seen in Sherburne and Mendon in 1913. One was reported killed in Lincoln in 1932, but this record could not be checked.

Mustela cicognanii cicognanii Bonaparte. Bonaparte Weasel.—This is the common weasel, found at all altitudes. Collected in Windham, Rutland, Windsor, and Essex counties.

Mustela noveboracensis noveboracensis (Emmons). New York Weasel.—Much less frequent than the Bonaparte weasel and confined more nearly to the Transition Zone. Collected in Windham and Rutland counties.

Mustela vison vison Schreber. Eastern Mink.—Formerly common along streams throughout the state; much reduced in numbers by trapping. One was taken within the city limits of Rutland in 1937. The Fish and Game Service records 6,500 reported caught in 1936.

Lutra canadensis canadensis (Schreber). Otter.—Rare along mountain streams and ponds. For several years five of these animals visited a small pond in Clarendon each spring. One was caught by a trapper in Wallingford in 1928. Three others of the group, one each in the years 1931, 1932, and 1933, were caught by boys trapping muskrats, almost within the town of Rutland. They are occasionally taken in Essex County and other parts of the state.

Mephitis mephitis nigra (Peale and Beauvois). Eastern Skunk.—Common throughout the state; prefers the vicinity of farms and villages. The Fish and Game Service reports 30,000 marketed during 1936.

Vulpes fulva (Desmarest). Red Fox.—Common throughout the state. Black and cross phases occasionally occur. There were 11,076 reported taken during the year 1936.

Urocyon cinereoargenteus borealis Merriam. Gray Fox.—This fox reaches its northern limit in Vermont. It has been taken as far north as Whiting (Champlain Valley), in western Vermont and in the eastern section as far north as Woodstock. E. A. Goldman examined a skull from Rutland and one from Springfield and referred them to this subspecies.

Felis concolor couguar Kerr. Panther.—Probably extinct. Published records agree that the last one killed was at Barnard by Alexander Crowell. It is described by Titcomb (1901) as follows: "The famous Barnard Panther was killed on Thanksgiving day, November 24, 1881, with a shot gun. It weighed 182 pounds and was 7 feet long. It was mounted and is in the State Collection at Montpelier." Since 1934 there have been repeated reports of panthers seen and heard in various parts of the state but to date none has been captured to secure the reward of $100 offered by a local paper for a Vermont panther, dead or alive.

Lynx canadensis canadensis Kerr. Canada Lynx.—Formerly taken occasionally. The local press records the capture of one of these cats from time to time. The last record actually checked was in 1928. This animal was killed by Roger Williams, who trapped it at Windham.

Lynx rufus rufus (Schreber). Bobcat.—Occasional in heavy woods. In 1936 one was killed at the city limits of Rutland. The Fish and Game Service reports bounties paid on 20 during 1936.

Phoca vitulina concolor (DeKay). Harbor Seal.—Reaches Lake Champlain by way of the St. Lawrence River. Thompson (1842) recorded it from Burlington in 1810. Kirk (1916) recorded it from Otter Creek in 1846, and from Weybridge in 1876. Two are preserved in Vermont museums.

Marmota monax rufescens Howell. Rufescent woodchuck.—The common marmot throughout Vermont. Found at nearly all altitudes; recorded from Rutland, Ferrisburg, Lunenburg, and East Wallingford.

Marmota monax preblorum Howell. New England Woodchuck.—Howell (1915) recorded this subspecies from Rutland but Kirk (1922) stated that specimens sent later to Howell had been pronounced *rufescens*. A single specimen taken at Saxton's River has also been identified as *preblorum* by Howell.

Marmota monax canadensis (Erxleben). Canada Woodchuck.—Howell (1915) provisionally referred a single skin without skull from Mt. Mansfield to this subspecies.

Tamias striatus lysteri (Richardson). Northeastern Chipmunk.—Common at all altitudes.

Tamiasciurus hudsonicus loquax Bangs. Eastern Red Squirrel.—Common. All red squirrels so far collected are of this subspecies. An occasional specimen approaches *T. h. gymnicus*.

Sciurus carolinensis leucotis (Gapper). Northern Gray Sauirrel.—Common in open hardwoods; rare above 2,000 feet altitude. During the fall of 1936 there was a migration of these squirrels that extended over most of Vermont. The movement was from east to west. A late frost in the spring of 1936 had destroyed the nut crop. Rutland was invaded by squirrels, some of which remained until the spring of 1938. In Essex County, at Brighton, we were told of squirrels at the farm house near our camp. They were entirely absent from that district previous to the migration. At Saxtons River, Windham County, there were no reports of a migration. The local press of that fall recorded damage to crops and power lines in Madison and Onondaga counties, New York. Two dozen were also reported as drowned at Catskill, N. Y. while attempting to swim the Hudson. At the present time they have not returned to the former range in anything like their former numbers.

Glaucomys volans volans (Linnaeus). Small Eastern Flying Squirrel.—Occasional in suitable localities; entirely confined to the Transition Zone. A marked decrease in numbers has been noted ever since the migration of gray squirrels. Collected in Rutland and Windham counties.

Glaucomys sabrinus macrotis (Mearns). Mearns Flying Squirrel.—Occasional in Canadian Zone or in cool swamps or evergreen timber in the Transition Zone. A marked

decrease has been noted in numbers since 1936. Collected in Windham and Rutland counties.

Castor canadensis canadensis Kuhl. Canadian Beaver.—The original stock is long since extinct, but there are a few isolated colonies that have been introduced. There is an old dam at Bristol and these animals are said to have migrated to Lincoln. Dana Carpenter reports a colony at Bowen Pond in Stratton in 1928. Kirk (1923) writes of the introduction of beavers from the Adirondacks into Stamford, Bennington County, in 1921. During the fall of 1936 a pair of young beavers constructed a dam on North Brittain Brook, Castleton. They were continually molested and in the spring one was found dead a short distance down the brook.

Peromyscus maniculatus gracilis (LeConte). LeConte White-footed Mouse.—Common throughout the state at elevations above 1,200 feet; prefers cool moist woodlands. Taken at Mendon, Sherburne, Brighton, Brandon, Dorset, and Readsboro.

Peromyscus leucopus noveboracensis (Fischer). Northern White-footed Mouse.—The common white-footed mouse of the Transition Zone. Range extends in the Champlain Valley to the Canadian border. In eastern Vermont taken as far north as Wells River by Wendell P. Smith. Confined to altitudes under 1,200 feet but the ranges of *noveboracensis* and *gracilis* overlap wherever they meet.

Synaptomys cooperi cooperi Baird. Cooper Lemming Mouse.—First recorded by Kirk (1916) from Mt. Killington. Collected at altitudes varying from 550 to 4,000 feet in Sherburne, Leicester, Mendon, Rutland, Rockingham, and Shrewsbury.

Synaptomys is comparatively rare and very local. As far as I have been able to learn less than two dozen have been taken so far in the state and of these I have been fortunate enough to take about fifteen.

Clethrionomys gapperi ochraceus (Miller). Mt. Washington Red-backed Mouse.—Vermont specimens of this mouse seem to be intermediate between *ochraceus* and *gapperi*. G. M. Allen, after checking a number of skins from all parts of Vermont, refers them to *ochraceus*. Collected in Windham County at an altitude of 600 feet, but in Rutland and Essex counties confined to Canadian Zone.

Microtus pennsylvanicus pennsylvanicus (Ord.). Eastern Meadow Mouse.—Common in various situations to highest mountain tops. Taken on Mt. Killington at an altitude of 4,000 feet.

Mircotus chrotorrhinus chrotorrhinus (Miller). Rock Vole.—A single specimen was taken by G. L. Kirk, June 24, 1937, at Brighton, Essex County.

Pitymys pinetorum scalopsoides (Audubon and Bachman). Mole Pine Mouse.—The first specimen was taken in August, 1936, at Sherburne, in Canadian Zone forest at an altitude of 1950 feet. Six more were taken the same month at Rockingham in tunnels at the edge of an oat field in Transition Zone habitat, at an altitude of 550 feet.

Ondatra zibethica zibethica (Linnaeus). Eastern Muskrat.—Formerly abundant along streams and ponds; numbers greatly reduced by the cold winter of 1933–34 and by constant trapping by the unemployed. Numbers increasing slightly during 1937–38 in counties where fall trapping is prohibited. The Fish and Game Service reported 72,726 caught in 1936. Has been taken within the city limits of Rutland within a year.

Rattus rattus rattus (Linnaeus). Black Rat.—Confined to small colonies around farm buildings. Green (1936) reported it from Wallingford. It was collected at Rockingham and seen at Woodstock.

Rattus norvegicus (Linnaeus). Norway Rat.—Common everywhere around farm and city buildings and dumps. In the vicinity of Rutland these rats are a staple article of diet for owls of several species. They also furnish a new sport for young people who, after a show or other entertainent, drive to the dump, put on the spot light and shoot rats with small caliber pistols or rifles. It is said that this practice is carried on in all of the larger cities and towns in this section of the state.

Mus musculus musculus Linnaeus. House Mouse.—Common in buildings, and in summer may be found in woods and fields some distance from buildings, but cold weather always drives them back to warmer quarters.

Zapus hudsonius hudsonius (Zimmermann). Hudson Bay Jumping Mouse.—Common in meadows and marshy tracts. Occasionally found on highest peaks of Green Mountains and in wet grassy spots at high altitudes. Collected at Rockingham, Rutland, Clarendon, Mendon, Sherburne, and Pittsford.

Napaeozapus insignis insignis (Miller). Woodland Jumping Mouse.—Abundant about cool mountain streams and other moist places. Entirely confined to the Canadian Zone. Collected at Brighton, Sherburne, Mendon, and Wallingford.

Erethizon dorsatum dorsatum (Linnaeus). Canada Porcupine.—Common in mountainous regions. In regions where caves or holes in rocks are not available, hollow trees are utilized as dens, even when they are entirely on the ground.

Lepus americanus virginianus (Harlan). Virginia Varying Hare.—Widely distributed in mountain woods and swamps and in evergreens at lower altitudes; prefers Canadian Zone. Much less common than formerly, because of overhunting and the cutting off of evergreens. Collected at Mendon, Sherburne, Barre, Rockingham, Westminster, and Wallingford. In sections where these hares are continually pursued by dogs they have formed a habit of hiding in holes.

Sylvilagus transitionalis (Bangs). New England Cottontail.—This species has spread northward rapidly during the last forty years, as noted by Kirk (1916). At the present time it ranges to the Canadian border on the west side of the state and on the east side at least to Montpelier. The vertical range has also been increased and cottontails now range up to 2,500 feet altitude. Collected in Windham, Windsor, Rutland, and Bennington counties.

Odocoileus virginianus borealis (Miller). Northern White-tailed Deer.—Nearly extinct soon after 1850. Introduced near Rutland in 1878. At present common throughout the state in wooded portions. The greatest concentration is in southern Vermont, in Windham County. This is probably due to better food conditions and slightly milder climate, coupled with ideal conditions for concealment in sprout growth. The deer kill for 1937 was between 3,000 and 4,000; the average weight, 149 pounds; smallest, 70 pounds; largest, 287 pounds. There were 240 deer killed illegally. These figures were released to the press by the Fish and Game Service.

Alces americanus americanus (Clinton). Eastern Moose.—The native animals are extinct. One was killed in Wenlock, Essex County, in 1900. Several strays have also been seen. A special trip was made to see one killed in the summer of 1919 at Charlestown, New Hampshire, just across the Connecticut River from Springfield, Vermont. During the past few years moose have been seen at St. Johnsbury, Randolph, Brattleboro, and other places. Although a few strays may wander into northeastern Vermont, those observed may quite possibly be escapes from game preserves at Corbin's Park, near Cornish, New Hampshire, or from a similar preserve in Massachusetts, as noted by Warfield (1937).

In addition to the mammals listed, James Silver in his report on "The European Hare (*Lepus europaeus* Pallas) in North America" (Journal of Agricultural Research vol. 28, no. 11, June 14, 1924), says: "In 1915 a hare was shot as far north as Fair Haven, Vt. by the State Fish and Game Commissioner, but as no others have since been seen this far north, the Massachusetts-Vermont line may be considered the northern limit at present."

Several hares of this species have been killed in or near southwestern Vermont and brought into Rutland. Reports are also frequently heard of European hares from other sections of southern Vermont but no specimen has been examined.

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OBSERVATIONS ON THE GROWTH AND BEHAVIOR OF HARVEST MICE

BY HAROLD J. LERAAS

A pair of *Reithrodontomys montanus albescens* Cary taken alive at Hackberry Lake, near Valentine, Nebraska, in July, 1933, while I was a member of an expedition from the Museum of Zoology of the University of Michigan, was sent to the Laboratory of Vertebrate Genetics of the University of Michigan at Ann Arbor. Later I took the stock with me to the Cranbrook Institute of Science, Bloomfield Hills, Michigan. Four young were born to the original pair of mice. The young of this litter, after reaching maturity, produced other litters, as did also the original pair, so that a total of 40 young harvest mice, in 14 litters, was observed during the study.

Characters at birth.—The mice at birth weighed from 1.0 to 1.3 grams with the exception of two dwarfs that weighed 0.94 and 0.88 grams respectively. The mice were weighed daily, and there was much individual variation. The total length (nose to tip of tail) at birth, as nearly as could be determined, ranged from 7.0 to 7.6 millimeters. The skin was reddish-pink and without hair. The eyes appeared as small blue-gray spots beneath the skin. I

could detect no openings for the eyes, ears, genitalia, and anus at birth, and no teeth were visible. A few hours after birth, the young could kick feebly and emit faint squeaks.

One day old.—The skin on the dorsal surface had a purple hue due to the pigment of the hair in the skin. The mice showed a slight increase in weight and were a little more active.

Two days old.—Down-like hairs had developed on the dorsal surface, and the skin appeared reddish-purple. The ventral surface was still naked and reddish-pink in color. On several occasions, while being examined, the young squeaked characteristically, and this immediately brought the mother from her nest to search for them. The squeak was high-pitched, and the notes

Table showing weights of Reithrodontomys montanus albescens from birth to 52 days

DAYS	WEIGHT IN GRAMS (AVERAGE)	EXTREMES IN WEIGHT
Birth	1.1	.88 to 1.3
3	1.6	1.3 to 2.2
6	2.4	1.8 to 3.4
9	3.3	2.9 to 4.5
12	3.8	3.4 to 6.1
15	4.8	4.1 to 6.8
18	5.4	4.3 to 7.5
21	5.8	4.7 to 8.1
24	6.4	5.4 to 8.5
27	6.9	5.8 to 8.8
30	7.8	7.0 to 9.4
33	8.4	7.5 to 10.1
36	8.7	7.9 to 10.2
39	8.3	7.9 to 10.2
42	8.8	7.6 to 10.3
45	8.6	7.7 to 10.2
47	8.4	7.5 to 10.2
52	8.6	8.2 to 10.6

followed in a rapid succession of from 5 to 8 per second. When the young mice were placed near the nest, the mother soon came to carry them inside, one by one. She carried them sometimes by the nape of the neck, sometimes by the back, and occasionally by the belly.

Four days old.—The hair had grown thicker on the back and the head. The post auricular regions, especially, appeared distinctly buffy in color. Hair was still absent on the ventral surface and the tail. The mice could now move by a kicking action, scarcely to be called crawling.

Six days old.—The hair was buffy in color around the eyes, ears, cheeks, and sides, but darker on the back. Black hairs were appearing along the rims of the ears. Short hairs had appeared on the dorsal side of the tail, and

also a few pale scattered hairs on the ventral surface of the body. The weight of the mice had been approximately doubled during the first 6 days. The lower incisors on some of the mice had just come through the gums, while the upper incisors were as yet uncut. Six dark tubercles showed distinctly on each hind foot. Nipples could be distinguished on the females. It was noted that when the tail of a young mouse was held against a light it appeared quite transparent, so that the vertebrae as well as both dorsal and ventral blood vessels could be clearly seen. The mice were able to move about, and the more active ones could climb out of a dish two inches deep. The crawl could now be described as a "wabble."

Eight days old.—The whole back was buffy, and a pale cream stripe appeared along each side. More hair had developed on the tail and the ventral surface. Both upper and lower incisors had appeared, and the eyes and ears had just opened. One mouse was observed to urinate on the eighth day.

Ten days old.—The margin of the ear showed a distinct black rim, the inside of the ear and pre-auricular tufts were buffy, the back side of the ear buffy-gray, and the postauricular tuft light gray. The tail was sharply bicolored. The mice now averaged about three times as much in weight as they did at birth. They were active, but still clumsy. When approached, one little fellow sat upon his haunches in a defensive position and made a low chirping sound. The voice was of a lower pitch than it had been in the two-day-old mice. One mouse was seen to defecate a small yellowish-orange particle. This was noted of others 11 days old. The upper front teeth had typical grooves extending down the front faces, although the teeth were only a little more than 0.5 mm. long.

Twelve days old.—The color of the young had become more like that of the adult, except that it was, in general, paler. The sexes were easily distinguishable at this age.

Fourteen days old.—In weight the mice now averaged about four times as much as at birth. The young ate oatmeal and sun-flower seeds. They still nursed the mother, although this was the last day on which they were observed to do so. They could run and jump very well at this time. They were handled daily and were becoming quite tame and, in time, some of them came to be free from fear and made attractive pets.

Changes from this time on were mostly in size. The color became gradually darker as the mice grew older. At five weeks, most of the mice were full grown, averaging about 8.5 grams in weight, and had the adult pelage.

Breeding habits.—A female born on July 3, 1934, had her first litter of two on September 26, 1934. Her second litter of four was born on October 23, and a third litter of four on November 14. A fourth litter of two came on March 31, 1935, and a fifth litter of two on April 20. This mouse had her first litter when she was 12 weeks old. The interval between the first and second litters was 27 days, between the second and third litters, 22 days,

while between the fourth and fifth litters, the interval was only 21 days. Another female had a litter of three on October 5, 1934, and a litter of two on October 29, an interval of 24 days.

The exact length of the period of gestation cannot be definitely stated because it is not known when the mice copulated. If *Reithrodontomys* mate within 24 hours after the birth of young, as appears to be the case in *Peromyscus*, then the gestation period apparently is 21 days. The number of young per litter varied from two to four. There were six litters of two young, four litters of three, and four litters of four each.

The female *Reithrodontomys* appears to be less combative while rearing young than the female *Peromyscus*. The male and female usually live peaceably in the same cage. In only one instance was it necessary to separate them. In this case, something unusual apparently occurred, since the female killed all the young after the male was removed. This same female later reared three litters peacefully with the male in the same cage.

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VERMONT JUMPING MICE OF THE GENUS NAPAEOZAPUS

By Carolyn Sheldon

In its native habitat, *Napaeozapus* is well protected under the cover of trees and bushes of the woods, but if startled this graceful creature can leap to safety at the slightest notice. Its bright yellow-gold sides are not conspicuous because when it crouches the blackish stripe on the back blends with the dead leaves of the forest floor or with trampled bracken. Nearly always these mice are taken in places sufficiently open to permit rapid and lengthy jumps. When stream beds dry up in summer these afford open paths easily followed, and along the banks, overhanging clumps of the Christmas fern, moss-covered rocks, and the wide leaves of wild ginger hide tiny holes or provide temporary shelter for the animal fleeing from danger. There *Napaeozapus* sits motionless, only its whiskers and sensitive nose quivering, dainty forepaws usually held off the ground, and ears erect. Generally this mouse can outdistance any mammal that may be hunting for him, but immobility too long continued is dangerous. Always he is poised for another jump if necessary, his strong hind legs drawn under the body and long white-tipped tail outstretched. One day I caught a *Napaeozapus* which I first etherized and marked before releasing. When fully recovered from the ether he entered the woods and was lost to sight until he was apparently frightened by a dog accompanying me. Then beyond the bushes fringing the woods in a dry streambed I saw him take three flying leaps in quick succession. He covered about 4 feet at a jump, clearing the ground by at least one or two feet each

time. As he landed he made practically no sound, and I did not see him again, so he probably found shelter in only a few seconds.

In the summers of 1934–1937, *Napaeozapus insignis insignis* was studied in the vicinity of Woodstock, Vermont. The country covered is about 1200 feet in altitude and includes steep hayfields, divided from each other by strips of bushes and saplings or broader strips of hardwood forest, intermixed with hemlocks and spruces. Many of the fields are overgrown with small white pines, poplars, willows, white birches, goldenrod, ferns, and other common meadow plants. Stone walls covered with wild grapevines are abundant, and there are numerous brooks and streams.

The mammal community included meadow jumping mice, deer mice, meadow mice, house mice, house rats, chipmunks, red, gray, and flying squirrels, woodchucks, porcupines, snowshoe rabbits, cottontail rabbits, short-tailed shrews, masked shrews, skunks, raccoons, weasels, minks, red foxes, bobcats, and deer.

I am greatly indebted to the farmers working in the vicinity of Woodstock and Pomfret, Vermont, for giving me information on jumping mice and allowing me to set traps in their fields. Among these I wish to express my gratitude especially for the help given me by the late Frank Lyford of Chelsea, and Philip Austin of Woodstock. Deep appreciation is due Vernon Bailey for his constructive criticism in the writing of this paper and to William H. Burt of the Museum of Zoology, Ann Arbor, Michigan, whose suggestions on studying home ranges have been invaluable. For using other important information I am indebted to Fred Osgood of Rutland, Vermont. I wish to thank the University of Michigan for the use of its equipment. I am also indebted to Louisa G. Sheldon and Harold Austin of Woodstock, Vermont for their care of captive mice in my absence.

Methods.—Metal spring-floor and milkbottle traps were used. Mice from some localities were kept in captivity and those from other places were etherized, marked in the field, and released where taken, to study home range. For these studies more than 100 traps were set 50 feet apart around three fields, covering agout 15 acres. All of the mice were taken around the edges of these fields, near brooks or stone walls, under wild cherry shrubs, hardwood saplings, and thick ferns. Under these were well worn runways several inches wide, used constantly by *Napaeozapus*, which also were taken in dry streambeds later in the summer when the high water of spring had disappeared. In 1934 colonies of *Napaeozapus* were found occupying a strip of hardwoods about 150 yards long. In 1935 none were present there, but a large colony was found about 250 yards distant along a stream in a strip of hardwood, where previously they were absent. In 1936, this place was deserted by them; but that summer they were taken in a small overgrown field adjoining these woods. The only three caught in 1937 were taken 170 yards distant from here, in another overgrown field at the edge of deep woods. This illustrates how local is the distribution.

At first jumping mice seem loath to enter traps and often will not be caught for more than a week after the traps have been set. Having entered more than one trap they usually continue to visit others along the line. If too long in the traps they are sometimes so weak from exposure that they finally die. One was found in a trap that had rolled into the shallow water of a brook and overturned. The mouse was wet, but healthy and very lively, so could not have been long in the trap. It is probable that *Napaeozapus* has a considerable tendency for wandering. This might explain why the traps are not entered the first few nights set. The mice, in the course of their travels, sooner or later come upon a trap and after that probably find others nearby and therefore stay in that locality, entering trap after trap where food is abundant.

Home range.—The studies of home range have not been very successful, even after 4 years of study. The numbers of mice were too few and many did not enter traps more than once.

The following are examples of *Napaeozapus* caught most often. In 1934 a male was first taken June 28; recaptured July 7, 125 yards distant; for the second time recaptured July 14, 86 yards distant; third, July 18, 60 yards distant; and fourth July 19, 50 yards distant. The fourth time he was very weak and later probably died or was picked up by some predator, as I saw no sign of him again.

In 1935, I took a male *Napaeozapus* first on July 11; for the second time July 15, 17 yards distant; and third, July 16, 117 yards distant. Approximately 117 yards is the longest distance I have found any jumping mouse to travel within 24 hours. This mouse was travelling progressively up a strip of hardwoods, apparently never doubling on his tracks.

Again in 1935, a female *Napaeozapus* was taken first on August 8; second, August 24, 30 yards distant; third, August 28, 30 yards distant; and fourth, August 31, 30 yards distant.

In 1935 a female *Napaeozapus* was caught first on June 23; recaptured June 24, 60 yards distant; taken for the third time June 30, 55 yards distant; and fourth, July 1, 50 yards distant.

In 1936 a female *Napaezapus* was taken first on July 6; second July 11, 40 yards distant; third July 20, 30 yards distant; and fourth, July 21, 40 yards distant.

Also in 1936 a male *Napaeozapus* was taken first on July 7; second, July 13, 80 yards distant; third August 7, 120 yards distant; and fourth August 9, 50 yards distant.

Summarizing the results of 1935 and 1936 (the most productive years, beside 1934, when many mice were removed), I have noted that in 1935, of 15 *Napaeozapus* taken that year, 5 (4 males and 1 female) were never recaptured; 6 (3 males and 3 females) were recaptured once; 1, a female, was recaptured twice; and 3 (1 male and 2 females) were recaptured three times.

PLATE 1. FIG. 1. Trees and bushes at the edge of hay meadows provide safe shelter. FIG. 2. Sherman metal box trap. FIG. 3. *Napaeozapus* in milk bottle trap devised by Vernon Bailey. FIG. 4. *Napaeozapus* are quiet and gentle. FIG. 5. The long tail and blackish back stripe blend with the natural surroundings.

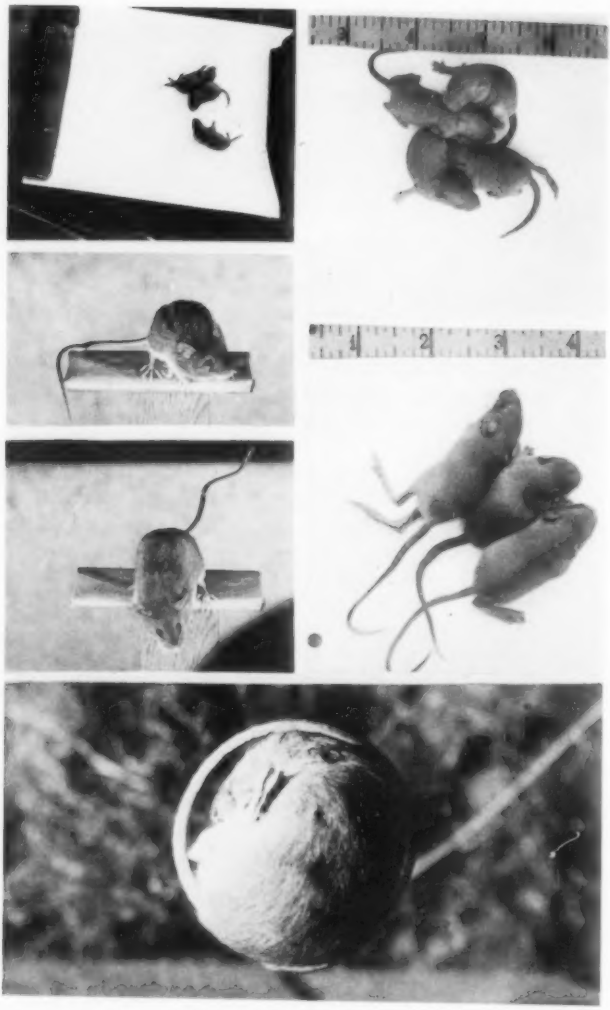

PLATE 2. FIG. 1. Litter of *Napaeozapus* 6 days old. FIG. 2. Another litter 11 days old. FIG. 3. The same litter 18 days old. FIG. 4. *Napaeozapus* is characterized by dark back stripe, lighter sides, and white-tipped tail (not shown). FIG. 5. An individual poised for a leap. FIG. 6. Side view of *Napaeozapus* hibernating. Photo. by Vernon Bailey.

In 1936, of 6 *Napaeozapus* caught, 2 (a male and female) were never recaptured, one, a male, was recaptured once, and 3 (1 male and 2 females) were recaptured three times. Apparently the number of males and females were about equal, and the males, on the average, travelled farther. I cannot, of course, tell just how far these mice travel, or how large an area was covered in one season, because I do not know where they were between times caught. All but one mouse were taken at the same time of year, so they probably do not stay in one location very long.

Abundance.—In 1934, I removed from the edges of fields, 21 *Napaeozapus*, and marked and released 9 of them. Of the captive individuals, 6 escaped and may have returned safely to their former homes, about 200 yards distant in a straight line. In 1935, I recaptured a female marked in 1934. She was taken 4 times from June 23 to July 1, 1935, and was not seen again. This was the only marked mouse recaptured in 1935. I found this to be the usual condition, as they were rarely caught a second year.

In 1935, I did not keep in captivity any mice caught around the three fields studied. Fifteen *Napaeozapus* were taken, including the one marked in 1934, and most of these were caught during August, so had probably already raised one litter of young or else were immature. In 1936, only 6 were taken. Therefore, in 1934 I caught 30 *Napaeozapus;* in 1935, 15; and in 1936, 6. In 1937 there was a marked decrease, so I took only two. Both these last mentioned individuals were taken twice, in the latter part of July. One was an immature male and the other a fully grown female. Fred Osgood of Rutland, Vermont, wrote in a letter dated October 11, 1937, that: "Only one Napaeozapus [was taken] in spite of repeated attempts to collect them . . . it was taken under the edge of a rock where the ground was as bare and hard as the middle of the road."

The years from 1934 to 1936 were unusually dry, but 1937 was unseasonably warm and rainy, causing floods in January and again in early spring. This weather may have drowned hibernating *Napaeozapus*. Lack of food could not have been a cause of this scarcity, because berries and other vegetation were exceedingly abundant. Also short-tailed shrews and weasels were very scarce, so it could not have been due to an increase in those enemies.

I trapped in more distant fields for specimens to be kept in captivity. One of these places was a strip of meadow about 100 yards long and 25 yards wide. At one end was a dense clump of alders growing in swampy ground that was under water for most of the year. Beyond was a mixed hardwood and coniferous forest leading for perhaps 50 yards into another narrow meadow. At the opposite end was a similar forest extending for about one-half mile. This strip of meadow was bordered on one side by a swiftly flowing stream several yards wide and on the other side by a wide road. Traps were set under the alders, by the river, and under the bank cut along the road. In this locality in 1935 I caught 15 *Napaeozapus*, 3 females and 12 males between July 29 and

September 7; in 1936 I took there five *Napaeozapus*, three females and two males, from June 22–25 after which date traps were not set. But in 1937 I took only one (a female) there on July 21, although traps were kept set from the middle of June until August 25. Here the mice may well have trapped out.

Another field adjoining the one just described was trapped in during 1935 only. Here I took 18 *Napaeozapus* (7 females, 10 males, and one of undetermined sex) between July 19 and September 8. In these two places males far outnumbered females.

General habits.—Quite often during summer nights my automobile headlights showed jumping mice, seemingly *Napaeozapus*, crossing narrow dirt roads. The mice took 3 or 4 short hops in clearing a road about 7 or 8 feet wide. They were never seen on the wider much-travelled roads, but only on narrow side roads. One road where they were seen was bordered by a hay meadow on one side and a pasture on the other. Traps set beside this road, however, yielded nothing. In 1937, not a single mouse was seen travelling across the roads.

Arthur and Ruth Svihla, writing of *Zapus trinotatus*, reported (1933, pp. 131–134): "On several occasions these rodents were seen to make a drumming noise by rapidly vibrating their tails against some resonant body as the bottom of a tin can or shreds of paper used for nesting purposes. They also make a squeaking noise when fighting." I have noticed the drumming of *Napaeozapus* as well; and one vibrated his tail, as I held him in the air by the scruff of the neck.

I have heard them squeaking when I poked their nests, as though they objected to the prodding, especially when the weather was cold and they were sleepy or about to enter hibernation. I kept one *Napaeozapus*, caught September 1, 1935, for more than a year and heard continuous squeaking in her cage every time I went into the room where I kept her.

Parasites.—W. J. Hamilton, Jr. wrote that "a Napaeozapus yielded several fleas." I have found a number infested by the larva of the bot-fly (*Cuterebra fontinella* Clark). This larva apparently leaves the body when the mouse is dead. The first I found was seen to emerge from the body of a *Napaeozapus* in a snap trap.

Food.—Unlike *Peromyscus*, *Napaeozapus* did not touch tent caterpillars. However, butterflies and moths offered were eaten with apparent relish. The bodies of a *Polyphemus* moth, two hawk moths, *Phascosphinx modesta*, and two butterflies, *Basilarchia arthemis* and *Papilio turnus* were eaten, but the wings were rejected. The bodies of a grasshopper and dragon fly were eaten, but bumble bees and beetles were refused. A butterfly chrysalis was not touched. Once, in the middle of the day, I watched a female *Napaeozapus* eating a *Polyphemus* moth. She had already eaten most of the body when

I saw her, but had a forewing in her front paws and was sitting up and chewing at a bit of flesh still clinging to it. Each wing she treated in like manner.

These mice ate the usual grass seeds found in their natural habitat, but did not eat dead mice, except newly born young. Nearly all berries, including strawberries, blackberries, raspberries, and red baneberries, were eaten, although blueberries, currants, and gooseberries were refused. They were extremely fond of sunflower seeds and when fed a mixture of those, rolled oats, and canary seeds, would always burrow down into the food can and dig out the sunflower seeds to the exclusion of all others. They also appeared to be fond of powdered milk even when it was mixed with a few drops of cod liver oil.

Nests, breeding, and development of young.—*Napaeozapus* probably nests in burrows or in deeper woods such as that described below by Arthur Stupka. Stone walls all through New England offer secure shelter for small mammals and I believe *Napaeozapus* lives and travels beneath them.

Arthur Stupka (1934) stated as follows: "On September 7, Mr. Vernon Lunt, CCC supervisor, working in the dense woodland about one-half mile south of the Tarn, came upon a globular nest made of leaves and dry grasses which was placed low in a brush pile. Upon investigating he found within this structure an adult and nine woodland jumping mice (*Napaeozapus insignis*)—an uncommon species of small mammal in the Acadia National Park region. Mr. Lunt captured six of the youngsters permitting the adult and three young to make good their escape . . ." I have never known *Napaeozapus* to have more than 5 in a single litter, but it is entirely probable that larger numbers have been born. The mammae number only 8, however, so I doubt if one mouse could satisfactorily raise 9 young.

Napaeozapus breeds readily in captivity and many litters were born while I was studying them. Nearly always the mother destroyed them within 24 hours of birth.

A female caught June 24, 1935, gave birth to a litter some time between 10:00 and 12:00 A. M. One young was seen wriggling beside her under a thin layer of shavings. It had the characteristic dark red coloring of newly born mice. I investigated the nest June 28 and found 3 young still alive and healthy, and by July 6 their squeaks resembled chirps, being louder than before, but they were not as vociferous as when first born. Four days after birth they had lost the dark red appearance, but had no hair. Each weighed about two grams, a gain in weight from the usual weight of one gram of new born young. By July 1 they still had no hair except the vibrissae, but their tails were noticeably longer and beginning to curl a little at the end. The weight of one was 2.3 grams. The nostrils were black in all. All seemed covered with a white substance like dandruff. The transparent skin was much wrinkled.

On July 9, a captive short-tailed shrew escaped from his cage and squeezed into that containing the young *Napaeozapus* then 16 days old. All were found dead, with the mother very much frightened and nervous. The measurements of one of the young were: Length 70 mm., tail 31, and hind foot 13. Their measurements can be compared with those of new born young recorded by W. J. Hamilton, Jr. (1935, p. 197), as length 42 mm., tail 12, and hind foot 5.

The mother was then put into a cage with a male, and 23 days later (July 31) she again gave birth to 3 young; but she killed them all.

After that I had no more success until the summer of 1937. I caught a female on June 28 and put her in a cage by herself. Twenty-five days later, at about 11:00 A. M. on July 21, I first noticed the characteristic whimperings of young. I did not want to risk disturbing them so did not investigate until July 31, when I decided to photograph them. I located the nest, made of dry leaves, under cover of long dry grass and spruce boughs. The mother jumped out and I removed her to a small temporary cage. There were 4 young apparently in excellent condition, very fat and full of life. There was a dark area on the back of each marking the position of the blackish stripe of hair in later life; the tails were dark with the white tip already visible, and the vibrissae were long and very noticeable. There was practically no other hair evident, except that in a strong light a filmy covering of fine hair could be seen on the back. One had a slight cut on his right shoulder.

On August 7, I again removed the young mice and found only three. I suppose that the one with the cut had died and been eaten by the mother. The nest was in the same place, but was scooped deeper in the earth, and more tightly woven across the top where I had broken in before. The three youngsters were very fat and vigorous. They were covered on the backs with a sleek coat of short golden hair that fairly glistened in the sun. The darker hairs of the back stripe showed through only faintly. The underparts were covered with a very thin coat of white hair, through which the pink flesh was still visible. The feet and tail were mostly bare. The eyes and ears were still closed.

On August 15, I again removed them from the cage. All had their eyes and ears open and were in adult pelage except that the back stripe was lighter than in older mice. One was smaller than the other two, but all three were females. The smallest weighed 9 grams and was not as lively as the others, which almost succeeded in jumping over a 6-inch enclosure when I tried to photograph them. All had fully grown incisors and one gave my finger a sharp nip. Until their eyes opened they were very vociferous and had been heard every day since birth. When the mother left the nest and when I removed them from the cage, however, they became silent.

On August 18th I permanently separated the three young from their

mother. They soon learned to build their own nest and get their own food. All three seemed especially fond of powdered milk.

On September 9, at 47 days of age, two weighed 27 grams each, and one 25 grams. The mother had weighed only 22 grams when caught.

Hibernation.—Napaeozapus, which are found so near the forest springs and woodland brooks in nature, must be forced to take up winter quarters far enough away to escape the flooding of the banks when the winter snow and ice melt. Nobody knows when they enter hibernation in the fall or when they emerge in the spring. In captivity there is great variation in individuals, but most become sleepy in late September or any time during October or November when the temperature becomes sufficiently low for discomfort. However, two males that I kept under observation remained active for many months, in spite of the fact that the temperature often dropped into the thirties. Nevertheless, at that time they forsook their above-ground nests in the cages and burrowed several inches under ground, where they carried nesting material and wove another nest. They refuse to use nesting cans sunk in the ground, but prefer to dig their own burrows. Often there will be a network of runways under the earth in a cage. The holes leading to the surface are usually plugged from the inside. It is interesting to note that in the fall of 1937 the three young went into hibernation at the age of 10 weeks, at about the same time as the other captive adults.

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Woodstock, Vermont.

EXPERIMENTAL DETERMINATION OF SUPERSONIC NOTES EMITTED BY BATS

By G. W. Pierce and Donald R. Griffin

It has long been suspected that bats might be capable of emitting and detecting sound waves of a frequency higher than the range in man. Hahn's experiments (Biol. Bull. vol. 15, pp. 135–198, 1908) indicated that the bat's ability to avoid obstacles was markedly impaired by plugging the auditory canal. This led to the theory that bats might detect high frequency sounds reflected from objects in their path. No very convincing proof could be advanced at that time, however, to show that bats could hear supersonic vibrations, or that any high frequency sounds would be available to assist them in detecting obstacles.

Therefore it is of some interest to record the results of some preliminary tests which Dr. J. Fisk and the writers made in the Cruft Laboratory of Harvard University in March, 1938. A microphone and amplifier had been developed for other purposes which made it possible to detect sounds far above the range of the human ear (the normal upper limit of audible sound is about 20,000 vibrations per second). Currents generated in the microphone by impinging sound waves are amplified by vacuum tubes and led into a loudspeaker along with a constant high frequency alternating current. A beat frequency is thus produced which activates the loudspeaker and in effect "translates" the supersonic notes into an audible frequency. By tuning the amplifier circuit for maximum loudspeaker output, the frequency of the impinging sound can be determined.

On several occasions bats of two genera (*Myotis lucifugus lucifugus* and *Eptesicus fuscus fuscus*) were held in front of the microphone. If they were angry, or disturbed, as when struggling to escape, the apparatus reproduced through the loudspeaker a volley of sharp notes having a frequency of about 48,000 cycles. The apparatus was sensitive enough so that this note could be detected when the bat was 25 or 30 feet from the microphone, but the individual notes were of such short duration (1/200 to 1/100 seconds) that close tuning by using beats was impossible, so that the frequency of 48,000 cycles given above may be in error by one or two kilocycles. These notes occurred at a rate of about ten per second, and they were of course entirely inaudible to the human ear without the aid of the apparatus. They occurred separately from the ordinary audible squeaking notes of the bat (which, incidentally, have a frequency of about 7500 cycles).

On close observation a "spitting" motion of the bat's mouth and throat could be noticed when these high frequency notes were being emitted. These motions occurred synchronously with the clicks from the recording loudspeaker, showing that the sounds were made by the mouth or larynx.

The bats were then allowed to fly about in a small room where the walls

and ceiling were padded with a thick layer of sound absorbing material. There was practically no reflection of high frequency sounds from these surfaces, for the 50,000 cycle sound artificially produced by the oscillator coupled to a Rochelle salt crystal as a radiator could not be detected, even with the sensitive microphone and amplifier, if the sound waves were directed away from the microphone so that they could reach it only by being reflected from the walls. Bats flew normally in this room, both in light and darkness, with eyes normal, and in the case of one *Eptesicus*, with eyes covered with black collodion. They approached the wall without any apparent confusion and either alighted on it or turned to avoid it.

By pointing the microphone at the flying bat we found that when first released the bat would emit a strident volley as he flew about, but usually the supersonic note had ceased by the time he had crossed the room and was preparing to alight on the wall or turn to avoid it. Since these bats had only recently been aroused from hibernation they were somewhat sluggish and usually had to be prodded with a stick to induce them to fly. Under such conditions the supersonic note continued only for a second or two after the bat had left his perch. Never during our observations did a bat begin his high frequency note *as he approached an obstacle*. These observations were repeated many times with consistent results, in lighted rooms, in semi-darkness (only the glow from the amplifier tubes inside a ventilated case) and with one *Eptesicus* whose eyes had been covered as described above. The behavior of this blinded bat was normal in every respect, as far as we could observe.

We could observe no noticeable response to sounds of 50,000 cycles produced artificially in the small room where the bats were flying. No confusion or impairment of their obstacle avoiding ability could be noted, either with normal bats or with the *Eptesicus* whose eyes were covered. We were thus unable to obtain any conclusive evidence that the bats *heard* sounds of these high frequencies. However, the regularity and vehemence with which the notes and the attending motions of the throat were made suggested strongly that we were dealing with a normal activity and not an accidental by-product.

The fact that supersonic notes were apparently emitted by the bats only when they were disturbed or at the beginning of a short flight, and the absence of the high frequency sounds when the bat was approaching obstacles suggest that they represent a call note or alarm signal of some sort rather than a means of avoiding obstacles.

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NOTES ON THE CRAB-EATER SEAL

By Alton A. Lindsey

The southernmost outpost of mammalian life is the Bay of Whales, 79 degrees S., 164 degrees W. In this southward extension of the Ross Sea, the Weddell seal (*Leptonychotes weddelli* Allen) is the only warm-blooded permanent resident, wintering beneath the new bay ice. This antarctic seal is essentially a coastal species. On the other hand, the crab-eater seal (*Lobodon carcinophaga* Gray) is pelagic. It frequents the drifting pack ice that encircles the antarctic continent. Since the pack is impenetrable to ships in the spring when the young are produced, very little is known of this seal's breeding habits. Our observations in the ice pack were made in mid-summer, 1933–1934, between 116 and 155 degrees W. In the Bay of Whales, the crab-eater is present only in summer and early autumn. It was observed, in all, from December through March during two seasons, 1933–1934 and 1934–1935. Work on this species was incidental to a study of the Weddell seal (Lindsey, 1937) and of the oceanic birds of the region.

Although the Weddell seal was found along tidal cracks in the bay ice as far as 30 miles south of open water in summer, the crab-eater is considerably more dependent upon unhindered access to the sea. It was not seen more than 3 miles back from the edge of the ice, and was much more abundant within one-half mile of open water. The food of the crab-eater consists very largely of the schizopod crustacean *Euphausia*, which is abundant and easily secured in open water or among drifting ice-floes. In addition, the crab-eater in the fast-ice, coastal habitat of the Weddell seal, is out of its proper ecological niche in relation to ice conditions. Its habits have evolved in the pelagic environment of the pack ice, and it lacks the Weddell's skill in rasping holes through the ice for breathing and for exit. The ice-sawing habit is the principal adaptation that permits the Weddell seal to winter beneath fast-ice at the extreme southern limit of its range. Probably a crab-eater would saw ice in case of necessity, but normally those few that summer in coastal bays use tidal and pressure cracks and the blow-holes maintained by the other species.

If the crab-eater seals that summer in fast-ice coastal areas are out of the species' typical habitat, how is their presence there to be explained? An answer is suggested by measurements of 61 crab-eaters taken in the Bay of Whales between February 9 and March 14, 1934, their carcasses being used to feed the members of the second Byrd Antarctic Expedition who wintered at Little America. The frequency distribution chart (fig. 1) gives the seals' lengths from tip of snout to end of tail. On the abscissa are shown these lengths, all of which fell between 61 and 97 inches, while on the ordinate are the numbers of individuals in each two-inch class interval. Females are represented below the dotted lines in each column, males above. Since

the measurements were all taken within about one month, the drop to the base line at the 81 and 82 inch column (except for one seal 81 inches long) separates the season's young from those in their second year. The season's young of the Weddell seal had not exceeded 75 inches by the middle of March, but the crab-eater is more precocious in several respects. Breeding hundreds of miles farther north, it produces its young about one month earlier than the mean date for the birth of the Weddell seals in the Bay, which was October 24. The only newborn crab-eater that has been described was found by Dr. Racovitza, the naturalist aboard the *Belgica*, which in 1898 was frozen into the antarctic ice pack and wintered there.

The young crab-eaters, then, which visit the Bay of Whales may reach a maximum of about 80 inches by the middle of March of their first year. Forty-two of the 61 individuals measured were less than one year old. Analysis of measurements of four dimensions throughout a series of 32 crab-eater skulls, taken at the same time of the year, led to a corresponding conclusion. Twenty-two of them, or approximately two-thirds again, are season's young, judging from the progress of suture obliteration and from the frequency distributions of the measurements. These skulls are now in the American Museum of Natural History. Field observations on the color of their coats, when compared with Wilson's description (1907) of the pelage changes, also indicated that these were young individuals, although not neccessarily in their first year. The best evidence from field observation is found in their freedom from scars. The presence of long, parallel scars from the teeth of the killer whale (*Orca*) is the general rule among adult crab-eaters. In the days of antarctic sealing it was found that about one-half the crab-eaters taken were so badly scarred in this way as to be worthless commercially. It is a striking fact that the great majority of this species in the Bay of Whales were completely free from old scars, although fresh gashes were commonly seen. These wounds were of the long, raking type inflicted by the killer, and had probably been incurred during the trip through the open Ross Sea from the band of pack ice to the Bay of Whales. The absence of healed scars on the skins of the youngest age group in the Bay strongly indicates that these were seals of the year that were born only six months previously in the pack.

What is the reason for the preponderance of first-year seals in the atypical bay-ice habitat? Since the gestation period is probably 10 or 11 months, the mating season follows soon after the birth of the young in the pack ice. The mature seals concerned with reproduction remain for the most part in the pack throughout the summer. On the other hand, many of the season's young make their way toward the continental coast in December or perhaps earlier, and constitute two-thirds of the number found in summer in the Bay of Whales. Of the few older seals that reached this bay, one-half of the females contained embryos. The latter were large enough to show that

the mating had occurred before the seals arrived at the bay, and probably in the pack ice. It appears that the southward movement to the antarctic coast in the spring and the return to the pack ice in the autumn involves chiefly young individuals. It is yet to be determined whether this movement is characterized by sufficient regularity and general participation to justify the term "migration."

In addition to freedom from reproductive activity, a factor to promote the southward movement of seals has been the presence of the killer whale in the pack ice zone. A more or less definite migratory instinct may have been fostered by natural selection, since the young that reached the shelter of protected bays and inlets along the coast would have a much better chance for survival than those remaining in the pack. Such an instinctive tendency to wander to the extreme southern limit of Antarctic seas may persist to some degree in adults, but in most of them it seems to be dominated by the reproductive instinct which opposes the southward journey by keeping the adults in the breeding area during the summer.

The frequency data in figure 1 furnish evidence regarding the age at which these seals begin to breed. The occurrence of embryos is indicated by "em" for each length class represented by females containing embryos. The smallest pregnant females fall in the column imediately after the hiatus between the first two age groups. It follows that the females may mate at the age of only one year and one or two months, and bring forth their first young when they are just two years old. This is one year earlier than in the Weddell seal (Lindsey, 1937), but the discrepancy seems less surprising when the rapid development of the young crab-eater is considered. The average Weddell pup has cut only its canines at birth, and the female nurses it for about 48 days before abandoning it. Racovitza (quoted by Wilson, 1907) wrote that the crab-eater pup at birth possesses perfectly functional teeth, that it is able to get around by itself at once, and that the mother leaves her young to shift for itself after nursing it for only two or three days after birth. In view of such a precocious infancy it seems credible that some of them swim from the pack ice to the Bay of Whales when 4 or 5 months old, and that a female may bear her first young when she has just turned two years old.

The vigor of the young crab-eaters is astonishing, especially when the sluggishness of the Weddell seals of all ages is considered. On one occasion early in January, I skied after a crab-eater that could not have been older than 4 months. Being thoroughly frightened it put forth its best efforts to escape. The front flippers were used to strike the snow with strong backward strokes, but the principal motive force came from tremendous blows against the well-packed snow with the hind flippers. The latter were held palms together vertically behind the end of the body, like a caudal fin. Combined with a rapid sinuous motion of the body, this mode of locomotion

furnished the closest analogy on snow to the way a fish swims in water. The results were remarkable. Although I ran along rapidly on skis close behind the animal, I was unable to overtake it in the first 300 yards.

Another incident illustrates the endurance of these seals in rapid surface travel. P. A. Siple pursued on foot a young crab-eater from the pressure ice up a narrow inlet that led to the expedition's main base. He kept the

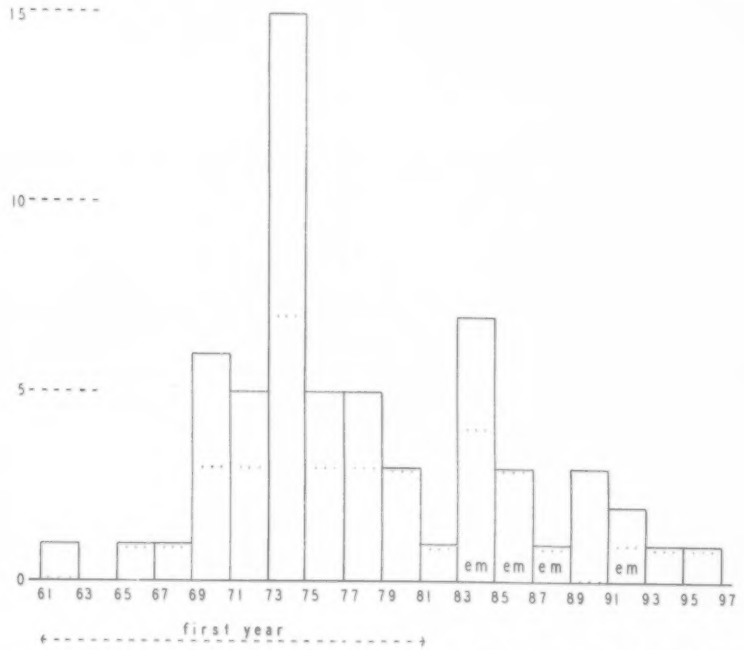

FIG. 1. Frequency distribution of nose-tail length measurements of 61 crab-eater seals measured February 9 to March 14. Class interval, 2 inches. Males above the dotted lines; females below. Ordinate, number of animals; abscissa, their lengths. Classes in which females contained embryos indicated by "em."

seal from greatly lengthening its lead only by sprinting at full speed over the hard-packed snow surface, and this continued for over one-half mile into the base camp. Here the seal made for the entrance tunnel to one of the buildings, and undoubtedly would have dived into the occupied building had not a bystander headed it off. Siple was completely exhausted by the continued exertion, but the seal had not been hard pressed at any time during the chase.

The table presents the means of three skull measurements for the three age groups that were recognized, from 32 skulls.

Means of skull measurements for age groups, in mm.

	0.5 YEAR	1.5 YEARS	2.5 YEARS AND OVER
Condylo-premaxillary length	245	270	285
Zygomatic width	131	136	155
Mastoid width	142	146	154

The skull of a crab-eater seal about 6 months old has the basioccipito-basisphenoid suture completely open. The frontal and parietal bones may

FIG. 2. Skull of a young crab-eater seal, showing the branched post-canine teeth. On closing the jaws these teeth dovetail to form a strainer for separating the sea water from the schizopod crustaceans constituting the food.

be partially fused together. In the larger skulls of this first age group the parieto-squamosal sutures are completely closed.

In the next group, consisting of individuals about 1.5 years old, the canines are larger, stronger, and have a more rugose surface. The interpalatine sutures are still completely open, but the basioccipito-basisphenoid sutures have begun to close. The parieto-frontal suture is closed but not obliterated, and the parieto-squamosal is almost obliterated.

At 2.5 years of age and older, the interpalatine suture is nearly or completely closed. In the oldest skulls it is obliterated. The basioccipito-basisphenoid suture is obliterated medially in all the skulls of this third

group, but may remain slightly open laterally in the 2.5 year seals. The interparietal suture is now completely closed, and the parieto-frontal and parieto-squamosal sutures are obliterated.

It is significant that the progress of the fusion of skull elements in each age group of crab-eaters parallels that in the Weddell seal. This indicates the validity of the above interpretation of age groups in the crab-eater seal, for which less material was available, and supports the conclusion that females produce young when two years old.

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RAISING THE YOUNG OF RED BATS ON AN ARTIFICIAL DIET

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On June 26, 1937, I received by express from Dr. J. R. Fowler of Ruston, La., a female bat, *Lasiurus borealis borealis*, carrying three young. These had been captured two days previous, June 24. The adult was somewhat emaciated, and every effort was made to recuperate her. That night the young were removed and the female given food. The next morning the young were returned to the mother and several attempts made to feed her. The strain, however, was too much, and she died the third day after, June 29.

The young, two females and one male, were probably from two to not over three weeks old. They were well covered with fur, eyes open, but with wings still undeveloped. There was little or no response to sound; either they did not hear or were too young to notice sounds. The two females were of the gray color phase, while the male was of the red color phase.

After the death of the mother, the young were fed hand-skimmed milk. The method of skimming leaves about 1% to 2% fat in the milk. The young were held suspended and the milk offered to them in a spoon. They took to it quite readily and drank about what I should judge their stomach would hold. They were fed three and sometimes four times a day. No scales were available, but it appeared as if they were at least holding their own and possibly gaining in weight. An attempt was made to feed them raw egg and milk, but this did not agree with them, and at the second feeding all three refused it.

Toward the end of the first week of feeding, some of the yolk of a hard-boiled egg was dissolved in the milk. This they seemed to like and it agreed with them. On Monday, July 5, one of the females ate a small amount of hard boiled egg yolk. Soon after, the others did the same. From then on, solid food was offered to them at each feeding. Cream and various cheeses were eaten readily at the first offering. Meat they refused at first, but later ate it gingerly. A day or so after accepting solid food, they were induced to eat a fly or two at each feeding, and this materially checked tendency to diarrhea. Later, the male and one female would eat flies and other insects greedily. The other female never seemed to enjoy the insects, although she would eat two or three flies at a meal.

A variety of food was tried. The young bats seemed willing to eat almost anything. By the end of the third week of captivity they were taking bread, cheese, meats (except salted), vegetables of nearly all kinds, lettuce, tomatoes, bananas, and raisins. "Jello" they ate eagerly the first time offered, and they were allowed to eat a considerable amount. This was found to be detrimental as it developed a thirst that was not healthy. Thereafter, only small amounts were permitted. It is interesting that these young bats so readily took to eating almost every kind of food. They can truly be said to be omnivorous.

Chitin in some form seems to be necessary to maintain a healthy alimentary condition; therefore the "dessert" of each meal was one or two flies or a honey bee, cut up. I have not found it possible, or even practicable, to feed insects exclusively. It takes quantities of them, and they contain so little nourishment that it is difficult to maintain weight, much less growth, on an exclusively insect diet.

Hand feeding of the young bats must be continued much longer than the period required merely to teach them to eat an unnatural diet; for the instinct of staying put where the mother leaves them when foraging for food is so strong that they refuse to leave the spot at which they are left hanging. These three young bats were kept in a small cardboard box, 10″ x 12″ x 8″; each young was suspended on a rag, one in each of three corners. It was not until the third week of feeding that one of the females ventured over to one of the other corners at night. Food was frequently placed on the bottom of the box, along with a dish of water or milk. In the morning, nothing had been touched. Occasionally, when the young bats were placed on the bottom near the food, they would eat a little, then crawl up in a corner and stay there, refusing to come down.

The question may be asked, why suspend each bat in a corner by himself? The answer is that they have a strong desire to nurse and will get hold of each other in the breast region and hold on tightly; sometimes they will cause a slight skin hemorrhage. Attachment of one on another in this manner prevents the normal voiding of urine and feces of both animals.

Human parents try to cure children of sucking their thumb; young bats when isolated will literally just about "suck their thumb." However, it is not quite the thumb, but the wrist just opposite to the thumb. Frequently, these young bats were found in this position. Furthermore, occasionally in eating, one would get hold of a morsel larger than usual and then just hold it in his mouth and suck.

Sound was first responded to on the fifth day after their arrival, and from then on they were more or less sensitive to it. When eating, any unusual sound would cause them to stop and contract, that is, the legs would be tightly flexed and the wings drawn together. After a week or ten days of this reaction, they apparently became accustomed to most sounds, and there was little response. However, a tapping or clapping sound would always cause them to stop feeding and listen.

The first attempt to move around from corner to corner came on the 14th of July and a week later one of them (the survivor) made a distinct attempt to fly. From the 14th on they were always active early in the evening, but quieted down after feeding. However, in the mornings they were usually found together in one corner, with one or two of them attempting to nurse.

On July 16 all three young developed a severe case of diarrhea, the cause of which was not ascertained. As in the older bats this condition proved to be quickly fatal, and two of the youngsters died the next day. The one surviving, a female, had always appeared to be the more active of the three and was slightly the larger, but had not been the chief feeder. The red-phase young had always been the best eater and was not particularly emaciated when he died.

As soon as the survivor recovered, the last evening feeding (usually given about nine) was omitted, and food was placed in the box, in an attempt to get her to feed herself. For two or three nights the food was not touched, but then she started to eat and within two or three days was eating enough so that she refused feeding in the morning. On July 25 all hand feeding was discontinued. For one or two days after, she seemed a bit lean, but this did not last and by the end of that week she was eating a full amount every night. For the next week occasional trials were made to get her to eat from hand, but she would not take anything without coaxing.

From the time she was weaned she was quite active at night and probably would have flown readily; in fact, she did make attempts to get away when out of the box.

A list of foods these young bats ate up to weaning age might be interesting: insects, milk, cheese (several kinds), eggs, bread (white, whole wheat, rye), crackers (soda, graham), potatoes (Irish, sweet), boiled corn, baked beans, lima beans, lettuce, banana, apple, tomato, peach, raisin, cantaloupe, watermelon, "jello," cake, meats of various kinds except salted meats, several kinds of wheat and corn cereals (the dry cereals soaked in a little milk),

and last and least, peanut butter. Of this entire list, insects, of course, are preferred, but the cheese was a close second; then the following in order: "jello," banana, eggs, and meats. All the rest are eaten with about the same amount of relish, except peanut butter, which is refused if they have had a taste of other food.

The incisors of bats are small and largely non-functional; neither the old nor the young are able to bite off a small portion of food from a large piece. Therefore, all food must be in small bites. They prefer a food of a moist, crumbly nature about the consistency of mashed, cold, hard-boiled egg, also a food that has a crispness to it such as lettuce, watermelon, etc. Experience so far indicates that bats do not detect or select their artificial food by smell; nor do they notice the presence of insects by smell. Their sight is keen, and they notice the presence of a particle, be it food or otherwise; they then taste it with the tip of the tongue, and either eat it or leave it alone. Sometimes food is taken into the mouth and then spit out together with a sort of sniffling.

The ease with which food is regurgitated, in both old and young, would seem to indicate that possibly the young may be fed on regurgitated food, till they are able to capture food for themselves. The rather extensive time, from the time the young are too heavy to carry around by the mother up to weaning, would further indicate that as the young grow older they must be fed captured food, and this may be regurgitated food. However, I am unaware of any observations on this.

Experience with a number of species has shown that it is quite practical to keep all of the common eastern varieties of bats in captivity. The one exception is the free-tailed bat, *Tadarida cynocephala*. Not only this, but it is possible to raise young bats to adults, at least from the time they are two weeks old.

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NOTES ON THE DENTITION OF A JUMPING SHREW (*NASILIO BRACHYRHYNCHA*)

By John Eric Hill

Only rarely is there available a sufficient series of a species to be able to follow the changes in dentition from birth to adulthood with reasonable certainty. The Vernay Angola and Phipps, Bradley Expeditions of the American Museum secured 177 specimens of *Nasilio* at Chitau, Angola, and 28 at Humpata, some distance to the south. These specimens were of all ages from newly born to old adult, and examination of the series disclosed some interesting conditions.

Skulls of recently born animals (November 10, two specimens A.M.N.H. 87646, 87647, with basal length approximately 17 mm.) do not have any teeth mature; that is, at the height above the alveolus these teeth would reach later. Deciduous $I\frac{1}{1,2,3}$ and the higher cusps of $dP\frac{3,4}{3,4}$ are all that would pierce the gums. The following dental formula can be determined from cleaned skulls: $dI\frac{1,2}{1,2,3}$; $dC\frac{1}{1}$; $dP\frac{2,3,4}{2,3,4}$; permanent $P\frac{1}{1}$.

The second stage is represented by a single specimen (November 20, A.M.N.H. 87456, basal length 21.0 mm.). Deciduous $I\frac{1}{1,2,3}$; dC_1; $dP\frac{3}{2,3}$ are fully developed into position and $dC\frac{1}{1}$, $dP\frac{2,4}{4}$ are approaching maturity. Deciduous I^3 and permanent $P\frac{1}{1}$ are barely discernible.

A number of specimens collected at various dates have complete deciduous dentition, $dI\frac{1,2}{1,2,3}$; $dC\frac{1}{1}$; $dP\frac{2,3,4}{2,3,4}$, and in addition permanent $P\frac{1}{1}$ (Fig. 1). One specimen, 87668, had a minute $dI\frac{3}{3}$, two-tenths mm. in height, on one side.

The deciduous teeth differ from the permanent ones as follows: Deciduous $I\frac{1}{1}$ is smaller than $I\frac{1}{1}$, and exhibits a small posterior cusp, while permanent $I\frac{1}{1}$ is simple, canine-like. Deciduous $I\frac{2}{2}$ has a hook-like anterior cusp which is relatively larger than in $I\frac{2}{2}$. Deciduous $C\frac{1}{1}$ is smaller than $C\frac{1}{1}$ with alveolar length of 1 mm. or less, rather than about 1.3 mm. Deciduous $P\frac{2}{2}$ is narrow, with two well-developed lateral cusps, a minute anterolateral one, and two small posteromedial cusps; $P\frac{2}{2}$ is much wider with four main cusps arranged almost in a square. Deciduous $P\frac{3}{3}$ exhibits three main cusps, two of which are lateral, forming an equilateral triangle, two small cusps anteriorly in relation to this triangle, and a small posteromedial cusp. Deciduous $P\frac{4}{4}$ is similar to $dP\frac{3}{3}$ but larger, with the posteromedial cusp as large as the medial. Permanent $P\frac{3}{3}$ is like $P\frac{2}{2}$, and $P\frac{4}{4}$ has a quadritubercular pattern like $M\frac{1}{1}$.

Deciduous I_1 is more flattened than I_1 and is trilobate (two lobes posteriorly placed), rather than simple. Deciduous I_3 is quadrilobate instead of bilobate as in the permanent tooth, and the crown is more elongate relative to the base. Deciduous I_3 and dC_1 are similar to the permanent teeth but

smaller; $dP_{\overline{3}}$ cannot be differentiated by me from $P_{\overline{3}}$. Deciduous $P_{\overline{3,4}}$ are larger and more complex than the corresponding permanent teeth; $dP_{\overline{3}}$ is the simpler, with one main cusp bearing a denticle on its anterior border, an anterior cusp and a posteromedial cusp, and two small posterior cusps set transversely. Deciduous $P_{\overline{4}}$ shows four anterior cusps arranged in a rectangle and four posterior cusps forming a triangle, the small posterior cusp nearly on a line between posteromedial and posterolateral cusps. Permanent $P_{\overline{3}}$ has three cusps arranged in a row, the posterior one somewhat elongate transversely. Permanent $P_{\overline{4}}$ exhibits a W-pattern similar to that of $M_{\overline{1,2}}$.

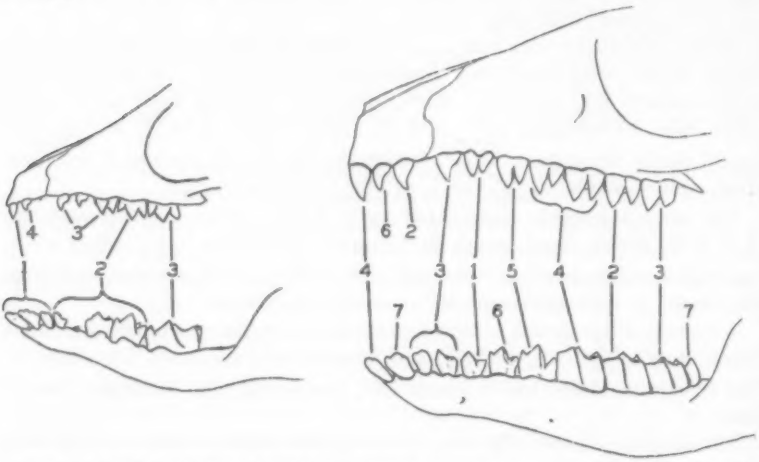

FIG. 1. (Left) Deciduous dentition, *Nasilio brachyrhyncha* (A.M.N.H. 87644), the numbers indicating order in which teeth reach mature position. FIG. 2. (Right) Permanent dentition, *Nasilio brachyrhyncha* (A.M.N.H. 85590), the numbers indicating order in which teeth reach mature position.

Some of the specimens of the third stage show the tips of $I^{\underline{2}}$ and $M^{\underline{1}}_{\overline{1}}$. $P^{\underline{1}}$ may reach its place before $P_{\overline{1}}$ but both are usually in position when $dP^{\underline{4}}_{\overline{4}}$ is fully in place. The basal lengths of these skulls are 23.0 to 23.5 mm.

Five specimens (A.M.N.H. 85585, 85589, 87657, 87662, 87666) have $M^{\underline{1}}_{\overline{1}}$ and $I^{\underline{3}}$ almost or completely in position, in addition to the deciduous teeth. $M^{\underline{1}}_{\overline{1}}$ take longer to reach maturity, but emerge above the alveolus first, $M_{\overline{1}}$ being slightly in advance of $M^{\underline{1}}$. The basal length at this stage is about 27.5 to 28.0 mm.

Six specimens (A.M.N.H. 85583, 84, 88, 96; 85609, 25) have $M^{\underline{2}}_{\overline{2}}$ emerging or completely in position. The youngest of these hardly differs from the fourth stage, except that $dI_{\overline{3}}$ is replaced by the permanent tooth. A slightly

older animal has $dC\frac{1}{1}$ replaced and $dI^{\frac{1}{1}}$ lost. Another of the group, however, with $M^{\frac{3}{2}}$ nearly in mature position has all the deciduous teeth except $dI_{\frac{3}{3}}$, while the oldest of the group without $M_{\frac{3}{3}}$ has only $dI^{\frac{3}{2}}$, $dP\frac{2}{2,3}$.

The last group of immature animals includes six (A.M.N.H. 85577, 85587, 85591, 85597, 85623, 85624), with basal length of skulls from about 28.5 to 30.7. These have $M_{\frac{3}{3}}$ partly up or almost completely in position. The younger of these, with $M_{\frac{3}{3}}$ barely showing above the alveolus, has $dC^{\frac{1}{1}}$ being replaced by $C^{\frac{1}{1}}$, $dP\frac{2}{2,3}$ with the permanent teeth underneath, but $dI^{\frac{3}{2}}$ are still present. An older specimen shows $M_{\frac{3}{3}}$ halfway up, $dI^{\frac{2}{2}}$ has been lost, $dI_{\frac{3}{3}}$ is replaced by the permanent tooth which is partly up. Permanent $P^{\frac{3}{3}}$ are almost mature and $P_{\frac{3}{3}}$ is visible under the deciduous tooth, while $P^{\frac{2}{2}}$ has replaced $dP^{\frac{2}{2}}$. By the time $M_{\frac{3}{3}}$ is in wearing position the entire deciduous set has been replaced, $I_{\frac{3}{3}}$ usually being the last tooth to take its place. The usual order of development of the permanent dentition is shown in figure 2.

Among the large series of adults there are several with anomalous dentition. A.M.N.H. 85592, an old male from Chitau, has $M^{\frac{3}{3}}$ present on both sides: the tooth is about the size of $I^{\frac{1}{1}}$ and does not show a pattern. In A.M.N.H. 85571, adult male, $M_{\frac{3}{3}}$ is present on one side only of the lower jaw. In A.M.N.H. 85586, adult female, $P_{\frac{3}{3}}$ on both sides is triangular, with only a single large cusp. In this animal $C_{\frac{1}{1}}$ on both sides is simple rather than bilobate.

The normal permanent dentition is $I\frac{1,2,3}{1,2,3}$; $C\frac{1}{1}$; $P\frac{1,2,3,4}{1,2,3,4}$; $M\frac{1,2,-}{1,2,3} = 42$. Shortly after the complete permanent dentition is in place the basioccipito-sphenoidal suture is obliterated. Although the youngest specimen is hardly larger than a full-term fetus, there was no indication of deciduous $I_{\frac{3}{3}}$, except in one specimen on one side. $P\frac{1}{1}$ are not replaced.

Compared with the order of dental replacement in *Rhynchocyon* (Allen, 1922, pp. 34, 35, fig. 1), there are several noteworthy differences. Deciduous $C_{\frac{1}{1}}$ develops later in *Nasilio* than the incisors; $dP\frac{3}{2,3}$ and $dP^{\frac{2,4}{4}}$ develop together, rather than $dP^{\frac{2}{2}}$ and $dP^{\frac{3,4}{3,4}}$. Permanent $P\frac{1}{1}$ are the first of the set to develop and appear some time before $I^{\frac{3}{3}}$. The lower incisors are irregular in replacing the deciduous set, $dI_{\frac{3}{3}}$ being one of the last teeth to be replaced, while in *Rhynchocyon* the incisors apparently are replaced in unison with $C_{\frac{1}{1}}$. The $C^{\frac{1}{1}}$ reaches maturity rapidly, taking about the same time as $C_{\frac{1}{1}}$. $M\frac{1}{1}$ are early in developing. $P\frac{2}{2}$, however, as in *Rhynchocyon* are among the last teeth to mature.

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SOME OBSERVATIONS ON THE BONNET MACAQUE

By Carl G. Hartman

In 1931, Dr. Warfield M. Firor returned from India with a collection of South Indian bonnet macaques (*Macaca radiata*), which included the adults that served as subjects for the following observations. These are here recorded since, according to Zuckerman's rather complete summary (1937), such observations are lacking for this species.

Weights.—The animals were weighed and measured (crown-rump and tail lengths) when received June 30, 1931. The data concern 8 of the largest males and 8 mature females that had borne at least one young. All arrived in excellent condition, thanks to Dr. Firor's supervision of feeding and care on the strenuous voyage from Bombay to Baltimore. The animals added little if any weight after arrival. A comparison with the rhesus monkey

WEIGHTS AND MEASUREMENTS OF 8 MATURE BONNET FEMALES AND 8 MATURE MALES

SERIAL NO.	WEIGHT (GRAMS)	SITTING HEIGHT (MM.)	TAIL LENGTH	SERIAL NO.	WEIGHT (GRAMS)	SITTING HEIGHT (MM.)	TAIL LENGTH
134	3930	436	585	L 11	6450	520	558
135	4420	420	634	L 12	6820	533	534
136	4040	440	552	L 14	6520	527	597
138	3410	403	596	L 15	7000	520	590
139	3520	420	508	L 16	5670	515	—
144	3570	413	482	L 18	6960	520	—
145	2930	412	534	L 19	6890	527	660
148	3660	410	564	L 20	6480	527	584

reveals the fact that mature females of this species are likely to weigh a kilo more when first breeding than the heaviest bonnet; and some rhesus females as well as males attain a weight double that of mature female and male bonnets. The rhesus monkey is, however, much more diversified than the bonnet (see Schultz, 1933; Miller, 1933).

Length of the menstrual cycle.—Only four cycles were recorded with accuracy. These were 25, 26, 31, and 36 days in length. One may infer, therefore, that this species follows the usual rule of the 4-week cycle obtaining, so far as known, in all primates (Zuckerman, 1937) except the chimpanzee, in which the menstrual cycle is of the 5-week type (Yerkes and Elder, 1936). On two occasions the flow was observed to last for 10 days in the bonnets; but such excessively long bleedings have also been observed in the rhesus monkey and in other primates.

The sex skin.—Pocock (1926) stated that "no trace [of a sex skin] is observed in *Macaca radiata* (*sinica*) or *irus* (*fascicularis*), both of which are long-tailed." That this statement was based on inadequate material has been

shown for *M. irus* by Corner (1932) and by Spiegel (1930, 1931), and is here shown also for *M. radiata*. Corner recorded in *irus* cyclic changes in the redness of the sex skin similar to that occurring in *rhesus*, and Spiegel added data on cyclic swellings, noting especially the more marked exhibition of these changes during pregnancy. Spiegel's observations closely parallel those now to be described for the bonnet macaque.

The sex skin of the bonnet is confined to the labia majora and to the circumanal region circumscribed by a triangle, the base of which is bounded by the dorsal margin of the sitting pads and the apex of which lies on base of tail 3 or 4 cm. caudad to the anus (cf. Spiegel, p. 573).

The labia majora, it may be stated parenthetically, are represented by two padded folds of skin (pudendal folds) overlying the symphysis and running rostrally from the clitoris. This interpretation, which I hazarded in 1928, is accepted by Spiegel (1928, p. 583) and by Wislocki (1936, p. 322). I now find that the same homology was drawn by Bolk in 1907.

In contrast to the condition in other macaques, red is not the predominant color of the bonnet's sex skin, for this consists for the most part of an inconspicuous dark purple. Red may be seen on the edges of the labia majora and in lateral streaks running from the sitting pads and the tail base.

During the menstrual cycle the coloration is never very marked and the changes are correspondingly slight. On two occasions regression of coloration was noted just before the menstrual flow set in.

In the course of pregnancy the purple color becomes very dark, almost black, in tone, and the red areas become brighter. In monkey no. 150, on the eightieth day of gestation, the sex color was compared with Ridgway's Color Standards (1912) and resulted as follows: The circumanal area, Dusky Slate Violet; buttock surrounding this, Anthracene Purple; the red margin, Indian Lake, or Eugenia Red.

Like the coloration, the swelling of certain areas is minimal outside of pregnancy. There may be a slight puffiness of the upper buttocks and the base of the tail (none is seen in fig. 7), with a frequent involvement of the labia (fig. 8). The best development of the sex skin, outside of late pregnancy, was recorded in those cycles in which conception occurred. The display at this time, although not conspicuous, was more marked than could be elicited in a castrate with 200 rat units of estrin (Amniotin Squibb) per day.

In the course of pregnancy the swellings appear at the end of the fourth week and attain a maximum by the fourth month. This is maintained to the end of pregnancy, receding slowly after parturition. As may be seen in the illustrations (figs. 1 to 4), the swellings involve chiefly the ventral surface of the tail base and the labia. The former becomes soft and flabby like a bag of gelatin, but the labia remain of a somewhat firmer consistency.

Sex responsiveness during the menstrual cycle and gestation.—In his dis-

cussion of the biological significance of the sexual skin, Zuckerman (1930) considered the brilliantly colored buttocks of certain primates as effective advertisements on the part of the females. Fortunately the females of other species decorated little or not at all have other means of making mating desire known. The bonnet females living in the same cages with potent males were found to have sperms in the vagina almost, though not quite exclusively, around the mid-interval between menstrual periods. In this respect the bonnets studied in the Carnegie Colony are more restricted in their period of receptivity than the brilliantly adorned rhesus females (cf. Ball and Hartman, 1935).

Castrated females living in the same cages with mature males copulate only when receiving injections of estrin. In one such case mating occurred persistently for a month, in another for two months during which 100 R. U. of Amniotin Squibb was injected daily (cf. Ball, 1936).

During pregnancy sperms were recovered in vaginal lavages only during the first seven weeks, which agrees which Ball's (1937) experimental findings in the rhesus monkey.

Gestation.—Monkey no. 150 gave birth to three babies. The first was still-born; the other two were healthy and nursed well. The gestation periods were estimated according to the following data.

1933 baby: Last menstrual period about January 27. Copulation took place for some days thereafter. Placental bleeding began between February 24 and 27 and continued to March 12 (duration 13 to 16 days). Estimated day of conception, February 10, day 14 of cycle. Parturition, July 13, 1933, still-born but well preserved male baby weighing 290 grams. Gestation period, 153 days.

Successive palpations during this gestation revealed at 46 days a uterine size corresponding to the normal stage characteristic of the rhesus monkey. After this, however, the bonnet uterus lagged behind that normal for the pregnant rhesus female. Since a similar retardation was noted in the 1935 pregnancy, which resulted in a viable baby, we may conclude that stages of pregnancy after the seventh or eighth week cannot be estimated in the bonnet monkey by reference to the chart worked out for the rhesus monkey (Hartman, 1932, p. 63). The pregnant uterus of the bonnet macaque, moreover, tends to remain elongated; that of the rhesus monkey more nearly spherical, until the middle of gestation.

1934 baby: On the basis of palpation on January 17 and 24, it was estimated that gestation had then advanced to days 40 and 47 respectively; hence conception was estimated to have occurred on December 6. A 330-gram female was born 166 days later (May 24). Since this baby seemed healthy, active and normal; and since a 330-gram birth-weight represents the lower limit of viability in the Carnegie rhesus colony (Hartman, 1932), we may conclude that the bonnet baby is about 25 per cent lighter in weight than the rhesus baby at birth.

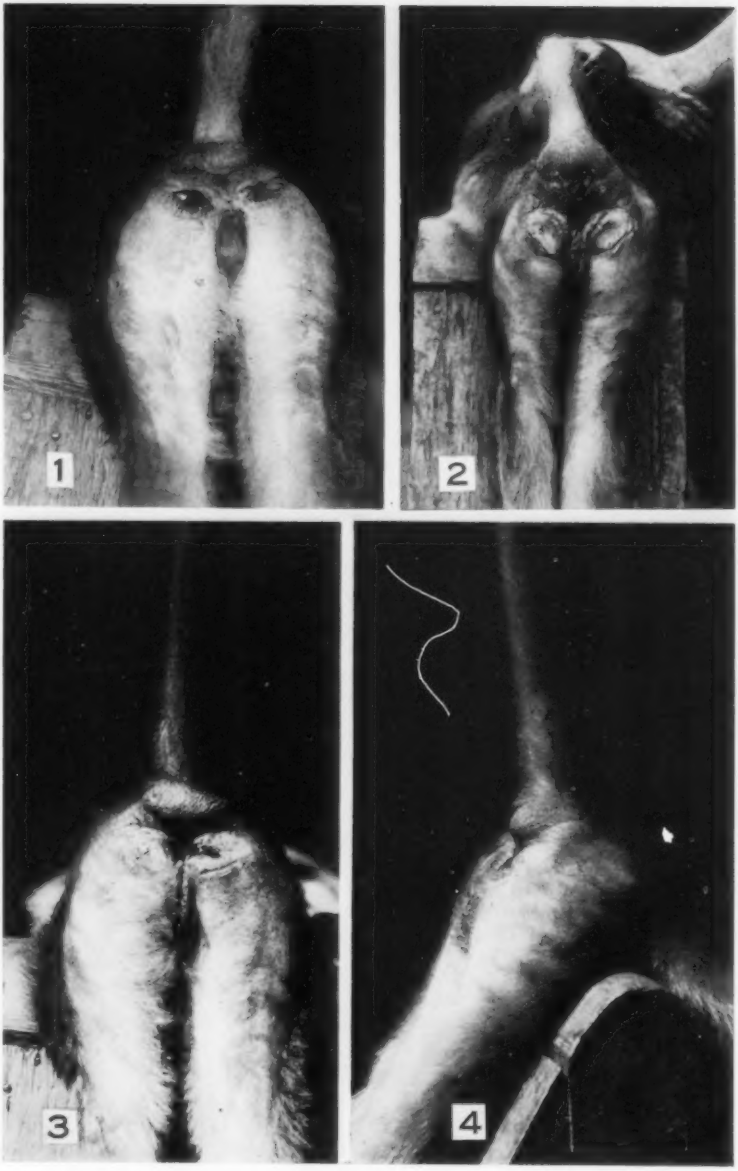

PLATE 1

The sex skin of bonnet female no. 150 in pregnancy. FIGS. 1 AND 2. In 96th day of gestation. In figure 1 the labia are best shown. FIGS. 3 AND 4. The 146th day of gestation. The swelling on base of tail is well shown here.

PLATE 2

FIG. 5. Section through cervix uteri showing complex nature of trabeculæ. At right, vagina; at left, uterus. Monkey no. 153. FIG. 6. Sagittal section through genital tract of monkey no. 142 to show tortuous nature of cervical canal. Vagina right; uterus left. FIGS. 7 AND 8. Buttocks of non-pregnant monkey no. 153 to show slight swellings (labia and circumanal region).

1935 baby: The 1934 baby was used in a crucial experiment November 2, 1934. Following this date sperms were recovered from the mother until the placental sign was first noted on December 18. December 1 seems a reasonable estimate for the day of conception. Pregnancy proceeded normally. On May 19, the 169th day of gestation, a normal 370-gram male baby was born. It died January 21, 1936.

Relaxation of the pelvic ligaments.—In all three pregnancies the pubic and sacroiliac ligaments became "relaxed" in late pregnancy, just as in the rhesus monkey. Two or three weeks after delivery the ligaments reverted to normal.

Ovaries and genital tract.—The ovaries of the bonnet macaque are more elongated and flatter than those of the rhesus, hence more like fetal or infantile glands. They are also more difficult to assess by rectal bimanual palpation (Hartman, 1932, 1933). In their histological structure the ovaries of the two macaque species are quite similar, especially in the small amount of theca interna present and in the abundance of hyaline bodies that represent the thecal remains of atretic follicles (cf. Frommolt, 1934).

The cervix uteri of the bonnet is much larger and more complex (fig. 5) than that of the rhesus and secretes a great deal more mucus; but the cervical canal is tortuous as in the rhesus (fig. 6). The vagina was pigmented in some cases for a considerable distance from the introitus, which raises the question as to whether or not pigmentation may be indicative of the origin of the lower portion of the vagina from the urogenital sinus.

Desquamation from the vaginal wall (Hartman, 1932) was never considerable in quantity in the bonnet females—less than 10 per cent of the vaginal lavage being a maximum as compared with 80 per cent in rhesus. Nor is the amount much increased in the bonnet with the injection of estrogens.

Summary.—In length of the menstrual cycle and the period of gestation, *Macaca radiata* conforms to Old World monkeys in general. The sex skin is quite inconspicuously purple-slate except for red on edges. Only in pregnancy does the sex skin exhibit its maximum in point of swelling of the labia majora and the base of tail. Matings occur most often in the interval between menstrual periods, not at all after the seventh week of pregnancy.

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TERTIARY MAMMALS OF KAZAKHSTAN

By J. A. Orlov

For the past 20 years paleontological expeditions of the Academy of Sciences of the USSR have obtained abundant Tertiary mammalian remains in Kazakhstan. The results of the work by these expeditions during the last few years is sufficiently important to warrant a detailed summary. An account is given here of the localities, horizons, and the mammalian remains as far as they have been worked out.

1. **Kievsky Settlement.**—Right bank of the Bala Kundusda River, tributary of Ulkun Kundusda River, which is the right tributary of the Nura River, 130 kilometers south of Aknolinsk. Discovered by J. Moshkara, explored by the Paleontological Institute of the Academy of Sciences of the USSR in 1935.

Character of site.—A few meters below the surface in compact spotted marly clay, identical in appearance with that of Pavlodar, Irtysh River (Orlov 1930, 1936; *Hipparion* fauna = Pontian). The bone beds extend below the water level of the Bala Kundusda River. Only broken bones and teeth are found. They are strongly mineralized, heavy, and dyed in dark color by the ferric oxides.

Mammalian remains.—Hipparions, Rhinoceroses, Giraffidae, and other representatives of the Hipparion fauna.

Horizon.—Pontian, lower Pliocene.

2. **Kulan Utmes River.**—Tributary of Lake Kurgalzin. Exact location: right bank of river, upstream from the mouth of Sonala River. Discovered by J. Moshkara.

Character of site.—Bony remains in surface deposits eroded from bank of river. Solid gypsum-bearing clay comprising base of bank, overlain by soft grayish-green clays.

Horizon.—Upper Tertiary.

3. **Tyul-Kulyusai.**—A ravine which descends into one of the tributaries of the Kara Turgay River; on the slope of the Ishim-Turgay watershed. Discovered by N. Volkova in 1935, explored by J. A. Orlov.

Horizon.—Pontian, lower Pliocene.

4. **Kara-Kol River.**—A tributary on the left side of the Ishim River. Discovered by N. Volkova in 1931.

Horizon.—Pontian, Lower Pliocene.

5. **Chuldak River.**—Right bank of river, 30 kilometers east-northeast of Bertchegur station, on the Orenburg-Tashkent railroad; east slope of Mugodzar Mountains. Discovered by G. Vodorezov.

Character of site.—Clays containing unionids.

Horizon.—Pontian, lower Pliocene.

6. **Myn-Su-Almas.**—Northwest Ust-Urt Plateau. Discovered by M. Zhukov in 1936.

Mammalian remains.—Mastodon and a few other remains.

Horizon.—Upper Tertiary.

7. **As-Kazan-Sor** (= As-Kazanyn Sor).—Salt pan in Bedpak-Dala Oasis, Golodnaya Steppe, about 300 kilometers east of Kyzyl-Orda (= Perovsk). The same beds are found in the basin of the Sary-Su River, northwest of As-Kazan-Sor. Discovered by D. Jakovlev in 1929, explored in 1936 by an expedition of the Academy of Sciences of the USSR, led by J. A. Orlov, and operating with Kyzyl-Orda as base.

Character of site.—Situated in desert country at south shore of salt pan, on slope of

As-Kazan Plateau. Limnic deposits with a top layer, horizontally deposited, of barren sands, about 3 meters thick, and a gravel layer, diagonally deposited, rather thin, dyed a brown color by ferric oxides, and cemented into sandstone. Bones in the lower (gravel) layer, highly silicified, ferruginous and whitish.

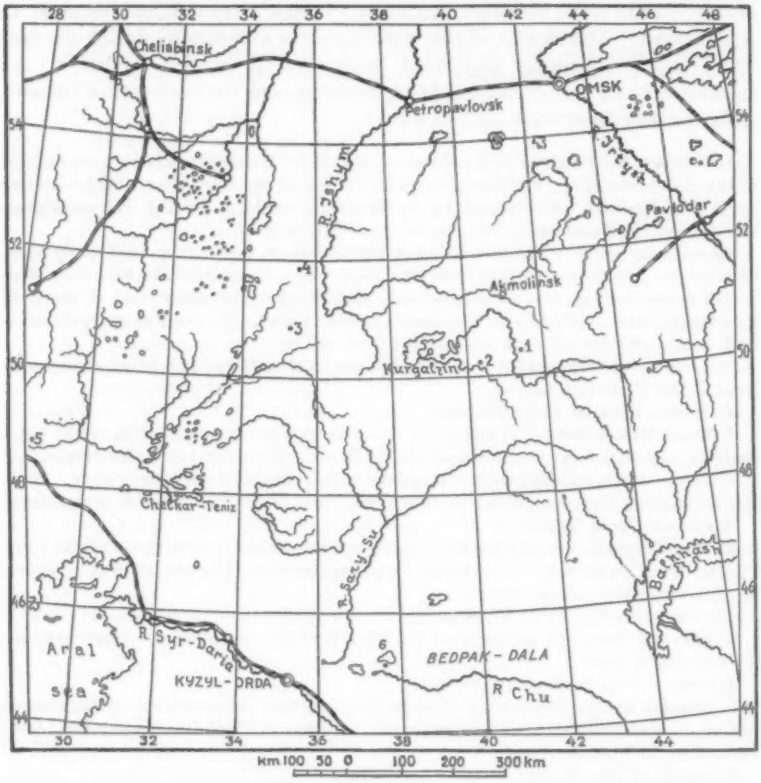

FIG. 1. Localities where Tertiary mammals have been found in Kazakhstan. 1. Bala Kundusda River. 2. Kulan Utmes. 3. Tyul-Kulyusay. 4. Kara-Kol. 5. Berekegur. 6. As-Kazan-Sor.

Mammalian remains.—Chalicotheriidae.—A large form closely resembling, if not identical with, the North American genus *Moropus*.

Rhinocerotidae.—Numerous remains. Of the two forms provisionally determined by Academician A. A. Borissiak one is closely related to *Brachypotherium* known from the lower Miocene Dzilantchik layers in the Turgay region, and the other apparently is identical with *Dicerorhinus tagicus* Roman, from the upper Oligocene and lower Miocene of western Europe.

Artiodactyla.—*Hemimeryx* sp.; *Anthracotherium* sp.

Proboscidea.—The complete absence of this group seems remarkable.

Carnivora.—*Amphicyon* sp., a species as large as a bear.—A representative of the Machairodontinae as big as a tiger.—Two carnivora of smaller size, not yet determined.

Rodentia.—One incisor, not yet determined.

Reptilia.—Undetermined remains of tortoises.

Plants.—Fragments of wood have been determined by A. Jarmolenko as a broad-leaved species of the lime tree type.

Horizon.—Identical with the Harrison beds of North America, that is, lower Miocene (Simpson 1933). The fauna is more recent than the upper Oligocene *Indricotherium* fauna, but probably older than the lower Miocene Dzilantchik fauna, described by A. A. Borissiak.

8. **Agypse.**—Fishery station, Lake Aral. Discovered by Prof. A. Alekseev; to be explored by the Academy of Sciences of the USSR.

Horizon.—Upper Oligocene.

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NOTE ON THE PINEAL GLAND OF THE HUMPBACK WHALE

By I. Gersh

Six pineal glands were furnished for study by Dr. Hans Löwenbach, of the S. S. "Frango," operated by the American Whaling Company, New York. They were preserved in 95% alcohol directly after their removal from the whales. The glands had been dissected free from their connective tissue and vascular investments before fixation. Since the glands are rather small the state of fixation is reasonably good. The data contained in this article, then, apply only to the alcohol fixed specimens; conclusions based on them may have to be modified as fresh glands or material preserved in more suitable fixatives become available for study.

The pineal glands of humpback whales are elongated egg-shaped objects with a slight constriction in their middle. Their surface is rough and bears the impression of blood vessels present in the capsule (see fig. 1). Note also in fig. 1 that the gland is attached to the epithalamus by a broad circular or oval base about 6 mm. in diameter. The same photograph illustrates also the fact that the pineal recess does not penetrate into the substance of the gland. The glands displace about 1 cc. of fluid. Their dimensions are somewhat variable; the table on p. 478 includes measurements on four of the preserved specimens.

For microscopic study, the glands were embedded in celloidin, one half being sectioned serially at 12 μ. They were stained in haematoxylin and eosin and mounted on large slides in gum damar. The observations that strike one at first glance are: 1) The arrangement of the parenchymatous cells

LENGTH OF WHALE IN METERS	SEX	DIMENSIONS OF GLAND IN MM.		
		Greatest length	Greatest width	Greatest height
14.3	♀	18.0	7.5	8.0
12.2	♀	14.0	8.5	8.5
13.7	♀	16.0	8.0	11.0
12.5	♂	14.0	10.0	8.0

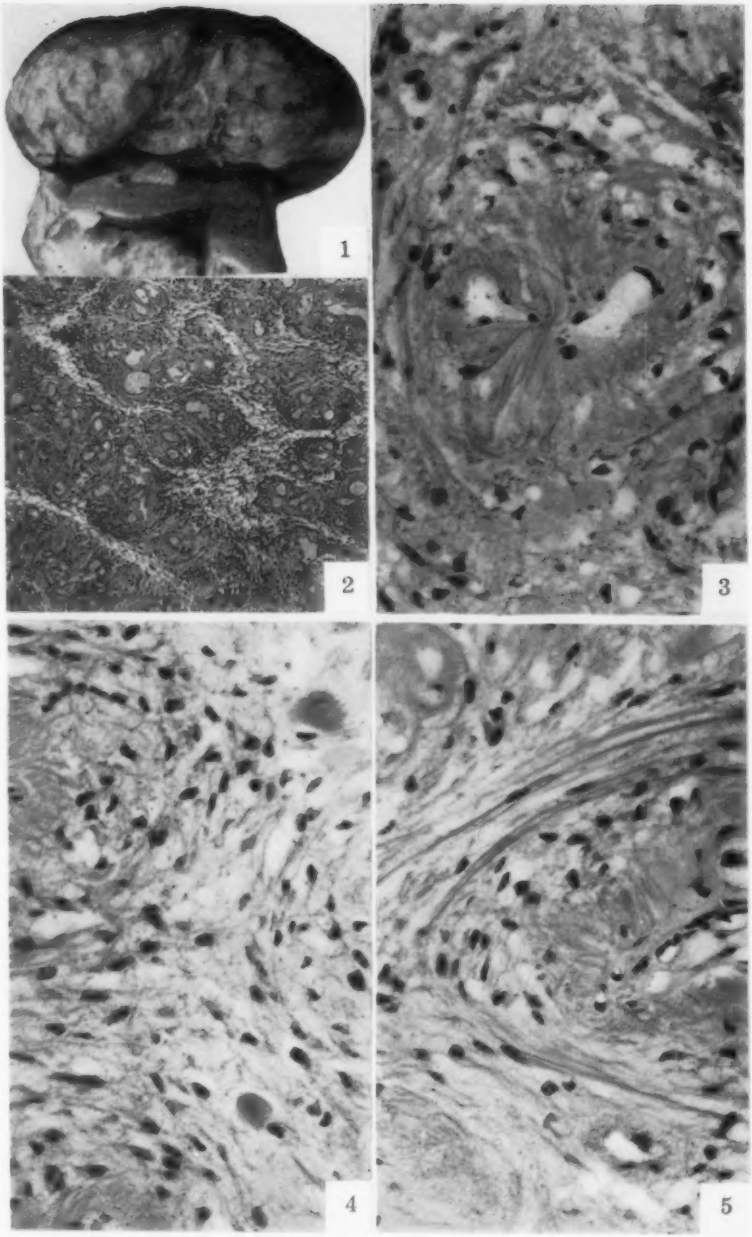
is similar to that which is characteristic of other mammals, especially the ox and man; 2) The bundles of blood vessels which divide and branch repeatedly throughout the gland do so in a manner which is typical of other organs in whales. (see fig. 2). In other words the parenchymatous cells and the blood vessels are quite definitely segregated into two related fields. These are described separately below.

The Parenchymatous Areas.—The cell body of the parenchymatous cells is located in the areas between the blood vessels. In sections the nucleus is small, oval or elongated, sometimes irregular in outline. It appears dark because it is filled with numerous very small, punctate chromatin particles. The cytoplasm surrounds the nucleus. The precise appearance of the cytoplasm or of its inclusions or organoids cannot be determined from the available material because these features were not well preserved by the fixative. It is obvious, however, that the cell body was attached in all directions to the adjacent blood vessels by cell processes. These cytoplasmic processes are shown especially clearly in figs. 3 and 5.

There are two special features observable in the glandular areas. The first is the presence of colloid masses resembling somewhat similar bodies in the hypophysis. These are irregular in size, usually stain with haematoxylin, and may appear granular or homogeneous (see fig. 4). The second is the occasional presence in sections of long sweeps of fibers which look like nerve fibers (see fig. 5).

The Vascular Areas.—The blood vessels are of large and small caliber. Whether or not they contain blood cells, they are almost always widely dilated. They appear to be kept in this state of distention by the layer of connective tissue which invests them and by the "stretching" action of the cell processes of the parenchymatous cells. The blood vessels themselves consist of a layer of endothelial cells. The larger areas are encircled by scant

FIG. 1. Photograph to show the surface appearance of the pineal gland of a female humpback whale, 47 feet long. Note also the nature of the attachment of the gland to the epithalamus, and that the pineal recess does not penetrate into the glandular substance. × 3. FIG. 2. Low power view of a section through the pineal gland to show that the tissue is divided grossly into two areas: 1) areas of blood vessels, 2) areas of parenchymatous cells. × 50. FIGS. 3, 4, 5. High power views of the same section to show the structural details of the areas of blood vessels and the areas of parenchymatous cells. × 300.



FIGS. 1-5

smooth muscle fibers. Even the finest blood vessels are restricted almost entirely to these areas. Very rarely a capillary that is not invested with a capsule may be seen in the glandular areas.

In summary, it appears that the parenchymatous organization of the pineal gland of the whale is similar to that of other mammals. This typical structure is modified in the whale by being superimposed on a vascular pattern which is characteristic of other organs in this animal.

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CAN THE WEIGHT OF WHALES AND LARGE FISH BE CALCULATED?

By Leonard P. Schultz

Numerous inquiries are made each year in regard to the weight of large sharks, big game fish, and whales. Although several authors have published formulae which were intended to answer this question, calculations made from them do not give results at all convincing as to their accuracy and usefulness for the various sizes of whales and sharks. The author has attempted, in this paper, to fit a curve to the actual length and weight data and express the results mathematically.

I am very grateful for assistance received in this study and wish, therefore, to acknowledge the kind cooperation and help received from the following persons: Dr. Remington Kellogg, of the U. S. National Museum, has supplied me with the lengths and weights of whale fetuses and references containing the lengths and weights of whales. Lieut. Q. R. Walsh, U. S. Coast Guard, whaling inspector, *S. S. Ulysses*, has turned over to me the lengths and weights of 17 whale fetuses obtained while he was stationed in the Antarctic from December, 1937, to March, 1938. Mr. Hugh D. Wise, Princeton, New Jersey, and Mr. E. M. Schuetz, Shark Products, Nassau, N. P., Bahamas, British West Indies, have furnished practically all of the length and weight measurements for sharks. Dr. E. D. McAlister, Smithsonian Institution, kindly checked the mathematical theory in this paper. Without the generous aid and willing cooperation of the above mentioned men, this study would have been impossible.

Data not received from the above acknowledged sources were extracted from the publications listed at the end of this paper.

Fisheries investigators have published numerous papers in which the relationship between the length and weight of fishes has been studied. In practically all species studied it has been shown that the weight (W) equals a factor (F) times the length (L) raised to some power (N). The value of

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F depends on the units of measurement and weight and thus would differ if these were in centimeters and kilograms, or inches and pounds. By plotting the logarithms of the weights against the logarithms of lengths for the specimens of sharks and whales on graph paper, it will be observed that these values arrange themselves in the form of a straight line, Fig. 1. Since this is true, the relationship between the length and weight can be expressed in the formula as follows: Log W = log F + (log L) (N) and since this represents a straight line, the values of log F and N can be calculated. The value of N may be determined from the slope of the line and the value of F is the point of intersection of this line on the Y axis. The following method was used for calculating the values of F and N, and is illustrated below from the data on whales:

For the whales, (table 1), averages were determined for the logarithms of the weights and the lengths for the 13 adults, respectively, log. 4.63527 and log. 3.25292. Averages were made for the 43 whale fetuses, as follows: Log. of the weight 1.87171 and log. of the length 2.30438.

$$N = \text{the slope of the line or } \frac{4.63527 - 1.87171}{3.25292 - 2.30438}$$

$$N = 2.914$$

The point of intersection of the curve on the Y axis may be determined from the above averages. Lines parallel with the axes of ordinates and abscissas and passing through these points form a triangle, if the line whose value is 1.87171 is extended along the axis of abscissas to the Y axis, then the latter axis forms the other side of a triangle, the two triangles thus formed, one above the line whose value is 1.87171, and the other below, are similar since their angles are of the same size. The sides of these similar triangles are proportional. Thus, the length of the side of the second triangle along the Y axis may be determined from the following values:

$$\frac{(2.76356)\ (2.30438)}{0.94854} = 6.36829$$

Measuring this value, 6.36829 on the graph along the Y axis from the value, log. 1.87171, it is found that the curve, if extended from the first triangle, will cross the Y axis at the value, log. $\bar{5}.1579$, which is the logarithmic value of F. Of course the least squares method, or some other means of calculating the values of F and N, could have been used, but the one presented here is sufficiently accurate for these data.

Some difficulties and errors were encountered in obtaining the data used in this study. The weights of the large whales may be somewhat larger in certain cases than the actual weight obtained because these monsters were cut up into pieces for weighing Possibly there would be some loss of blood

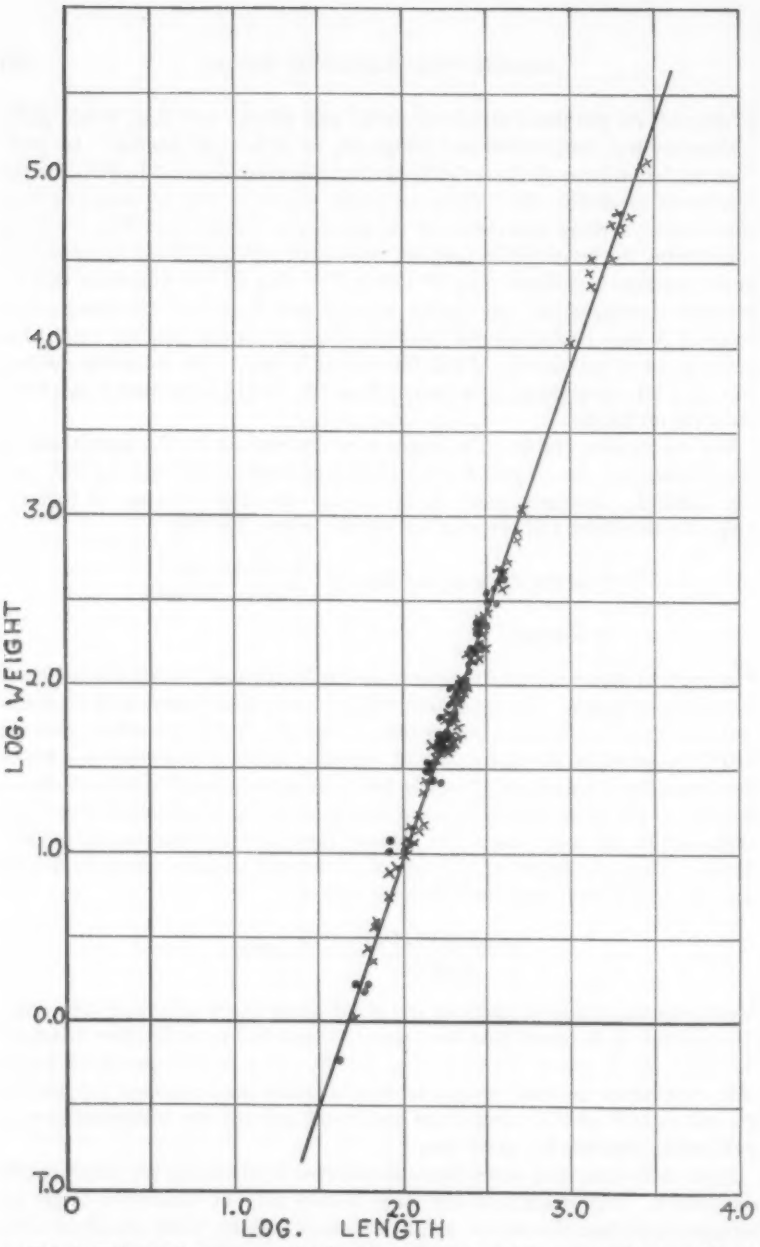

FIG. 1. This graph represents the data in tables 1, 2, and 3, expressed in logarithmic values. The straight line was fitted to the combined data for sharks and whales by the method of averages. X equals the whale data; ● equals the shark data; ▲ equals the blue marlin data; log of length in centimeters and log of weight in kilograms.

and other liquids which were not included in the totals of all the pieces. The lengths for the whales represent total lengths or are measured to the rear center of the concavity of the tail. In the case of sharks, most of the measure-

TABLE 1. LENGTHS AND WEIGHTS OF WHALES

SPECIES	WEIGHT, KG.	LENGTH, CM.	SPECIES	WEIGHT, KG.	LENGTH, CM.
Finback	57.0	185.5	Blue	263.8	333.5
"	207.0	302.5	"	244.5	291.9
"	138.6	271.9	"	1,111.5	523.1
"	530.9	438.0	"	57,777	2,372
"	226.2	305.0	"	158,180	2,950
"	702.3	480.4	"	48,903	2,030
"	220.9	284.0	"	122,004	2,718
"	16.8	127.4			
"	153.6	259.1	Humpback	32,374	1,390
"	476.5	412.5	"	27,880	1,292
"	304.5	341.1			
"	883.6	505.3	Gray	31,340	1,335
"	72.7	205.9			
"	27.2	138.0	Sperm	22,665	1,345
"	457.5	390.0	"	53,365	1,800
"	53,343	2,080			
"	48,600	1,990	Bottlenose	11,039	1,110
"	33,996	1,885			
Finback[1]	1.125	50	Finback[1]	27.25	140
"	2.75	60	"	28.75	140
"	2.5	60	"	37.6	150
"	4.25	70	"	40.25	160
"	3.85	70	"	45.125	160
"	5.75	80	"	43.5	170
"	8.18	80	"	70.0	180
"	8.0	90	"	57.87	190
"	8.5	90	"	75.0	190
"	10.125	100	"	87.8	200
"	11.0	100	"	88.0	200
"	12.5	110	"	94.6	210
"	13.06	110	"	115.25	230
"	18.25	120	"	174.0	250
"	18.91	120	"	180.0	260
"	19.2	130	"	197.6	270
"	23.5	130	"	300.0	310
			"	407.0	380

[1] The lengths of these fetuses were apparently measured to the nearest 10 cm. by Ommanney (1932).

ments are from the tip of the snout to the origin of the lower caudal lobe. It is not known to what point or part of the tail a few of the sharks used were measured. Thus these results are open to a certain amount of error. This

preliminary study is not intended to carry this relationship to fine details, as there are not available sufficient data, and the extreme sizes, both large

TABLE 2. LENGTHS AND WEIGHTS OF SHARKS

GENUS	WEIGHT, KG.	LENGTH, CM.	GENUS	WEIGHT, KG.	LENGTH, CM.
Carcharias	10.0	88.9	Ginglimostoma	51.8	167.6
"	14.1	96.5	"	65.9	170.2
"	136	252.0	"	67.3	182.9
"	455	386.0	"	60.0	184.4
"	30.5	142.2			
"	35.0	142.2	Prionace	433.6	383.1
"	50.0	188.1	Isurus	96.4	198.1
"	60.9	195.6			
"	76.4	182.9	Galeocerdo	26.7	157.5
"	162.7	254.3	"	42.3	188.1
"	211.4	284.5	"	193.6	289.7
"	31.8	147.3	"	351.4	325.1
"	33.5	152.4			
"	149.1	259.1	Sphyrna	11.8	88.9
"	122.7	274.3	"	409.0	381.0
"	296.0	377	"	26.0	165.1
"	.57	45.7	"	380.0	361.7
"	1.5	62.0			
"	1.6	63.0			
"	1.6	54.0			

TABLE 3. LENGTHS AND WEIGHTS OF THE BLUE MARLIN *Makaira nigricans ampla* (After Conrad and La Monte (1937))

WEIGHT, KG.	LENGTH, CM.	WEIGHT, KG.	LENGTH, CM.
41.4	195	120.5	248
64.5	210	135.7	273.2
66.0	221.5	141.0	270
79.5	222.8	147.2	259
81.0	225.0	148.0	264
88.6	221	161.0	272.5
94.5	232	164.8	281
97.7	255.8	172.3	269.5
99.0	235.8	191.0	291
112.9	242.5	209.0	304
		221.0	297.2
		235.9	280
		244.3	304

and small, would deviate from the calculated values more than the intermediate sizes. Yet, the author believes that the calculations presented will

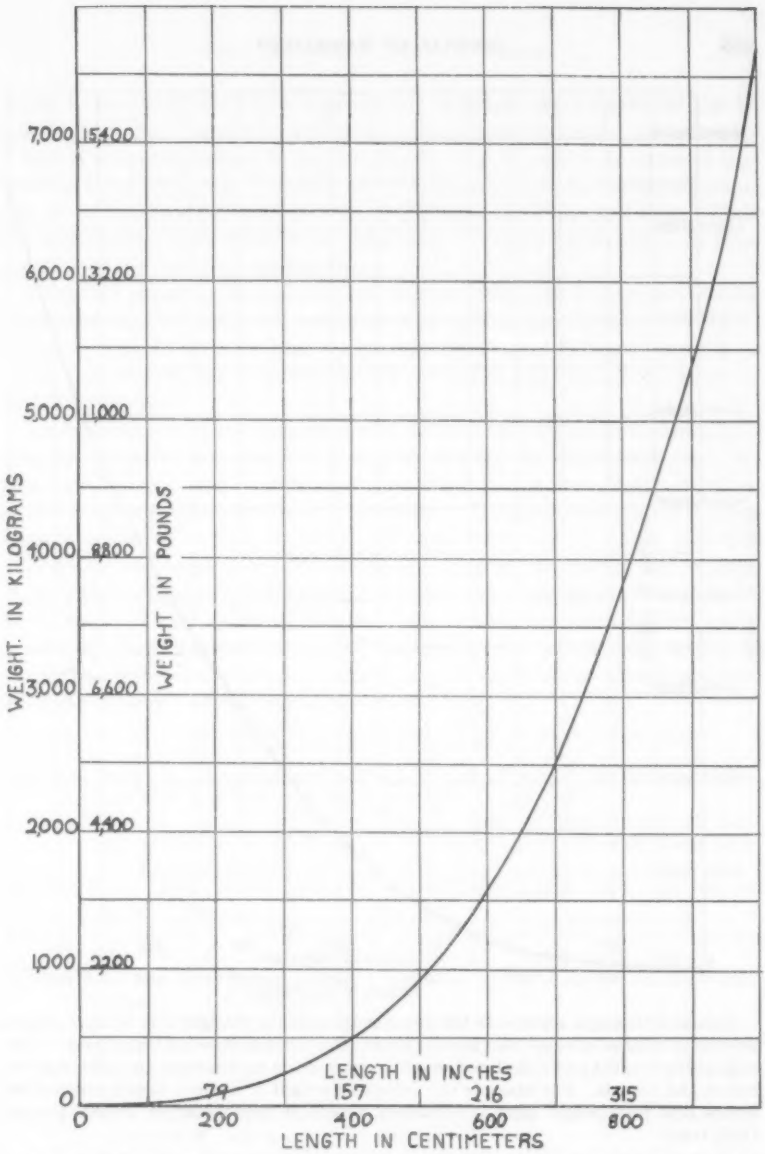

FIG. 2. This graph represents the lower portion of the straight line in fig. 1, but is presented in terms of whole numbers for those who do not wish to use logarithms. Corresponding lengths and calculated weights are given in centimeters and kilograms or inches and pounds. For example the weight of a shark that measures 157 inches to the lower lobe of the tail, would have a calculated weight of approximately 1,190 pounds.

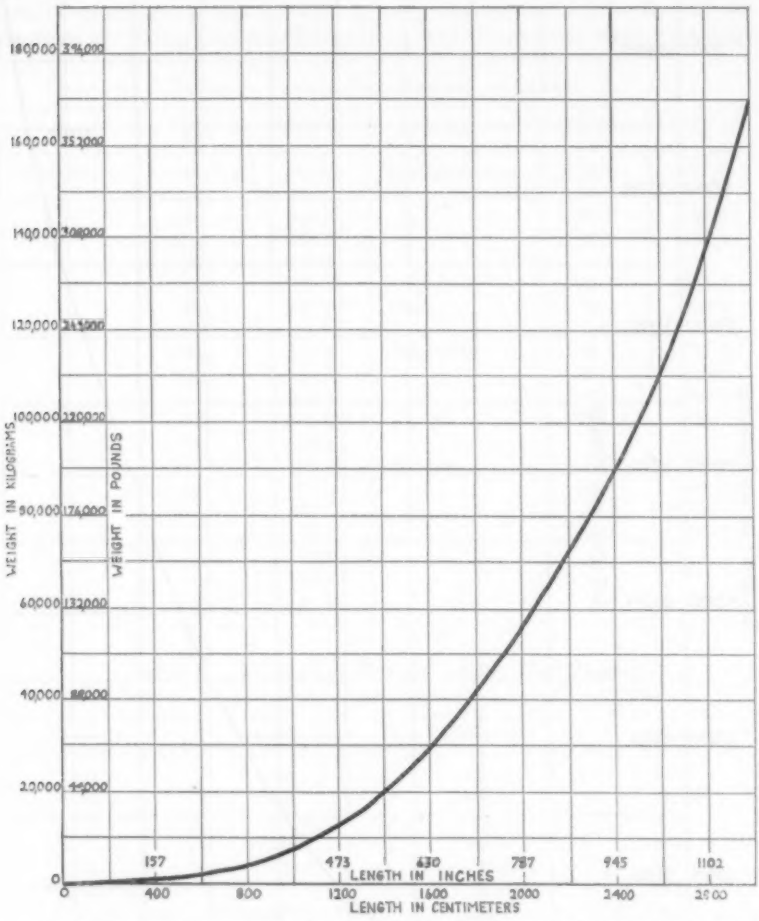

FIG. 3. This graph represents the upper portion of the straight line in fig. 1, but is presented in terms of whole numbers for those who do not wish to use logarithms. Corresponding lengths and calculated weights are given in centimeters and kilograms or inches and pounds. For example the estimated weight of a whale that measured 945 inches (78¾ feet) would have a calculated weight of approximately 205,000 pounds (102½ tons).

be useful and reliable if applied to large fish and whales which in general have the streamline shape.

Lengths and weights of 34 sharks were studied (Table 2). The data in

Table 2 were converted into logarithms. Averages were made for the 17 longest and the 17 shortest specimens. From these averages the values of F and N were determined in the formula $W = F L^n$, which in terms of logarithms is $\log W = \log F + (\log L)(N)$ and expresses the straight line in Fig. 1. N was found to have a value of 2.789 and log F equaled $\bar{5}.43$. Thus the formula may be written $W = .0000269\ L^{2.789}$ when the weight is in kilograms and the length in centimeters.

From the paper by Conrad and La Monte (1937), 23 length and weight measurements (Table 3) were converted into logarithms and plotted in Fig. 1. Since the lengths of these blue marlins are for almost the same size fish, a curve representing the true length-weight relationship can not be fitted to such limited data.

An examination of the data presented in this paper indicates that it is possible to calculate the approximate weights of large fish and whales from the formula $W = F L^n$ and to arrive at values which do not vary greatly from the actual weights and lengths given in the tables. Calculated weights at various lengths are given in Figs. 2 and 3, and from these curves, which were calculated by the formula for the combined data of the sharks and whales, ($F = 0.0000175$ and $N = 2.878$), the layman may make general estimates of the weights at corresponding lengths. The values are given in the metric system and in inches and pounds. Those who wish to convert the data from the metric system to inches and pounds may do so, since one kilogram equals 2.2 pounds, and 2.54 centimeters equal one inch.

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CRITICAL NOTES ON POCKET GOPHERS FROM TEXAS

By William B. Davis

In his monographic revision of the pocket gophers, Merriam (North Amer. Fauna, no. 8) considered *Geomys texensis* as a distinct species, stating that it is the smallest species of the genus in the United States. Bailey (North Amer. Fauna, no. 25) repeated this assertion when he named as *Geomys breviceps llanensis* the pocket gophers occurring on the opposite side of the Llano River, some 40 miles down stream from the type locality of *texensis*. In fact, Bailey went so far as to state that it needs but a cursory examination of the skulls to show that *llanensis* has no connection with *texensis*.

Recently I visited the type localities of these two gophers and collected a good series of each (22 *llanensis* and 16 *texensis*). In the field, I failed to find a single character that sufficed to distinguish one from the other. The descriptive term "little brown-backed, white-bellied gopher" does not apply to all individuals of *texensis*. Only one of the sixteen specimens has a white belly; the others are more or less plumbeous ventrally. I have been unable to detect appreciable differences in color in the two series of topotypes. Also, there is little difference in external measurements as is evidenced below.

To me, the most important cranial characters distinguishing *texensis* from *llanensis* are (1) shorter nasals, (2) larger, more inflated bullae, and (3) slightly narrower rostrum.

Although I have not found evidence of intergradation between *texensis* and *llanensis* (topotypes only available), the close similarity and overlapping of most cranial and external characters strongly suggest that their differences are of the nature currently recognized as distinguishing subspecies. The only geographic barrier separating the two populations is the Llano River which, in late summer, is nothing more than a series of shallow pools. This circumstance would conceiveably permit an intermingling of the two populations. Moreover, to me, the observed differences in the material at hand are no greater than those distinguishing *Geomys breviceps sagittalis* from *Geomys breviceps attwateri*, and certainly not as great as those separating *Geomys breviceps breviceps* from *sagittalis*, *attwateri*, or *llanensis*.

For the above reasons, it seems necessary to reduce *Geomys texensis* to subspecific rank, and let it stand as a subspecies of *Geomys breviceps*.

In studying the distribution and differentiation of pocket gophers in Texas, I have been impressed with the discontinuity of range of the genus *Geomys* in the eastern half of the state; also, with the difficulty encountered in referring to any described subspecies specimens from the Brazos River drainage basin between the black land prairie intersecting the basin in the vicinity of Waco, and the black land coastal prairie encountered about fifty miles south of Brazos County. Both of the blackland prairies proper are destitute of pocket gophers; they constitute an effective barrier to the dispersal of this rodent.

Differences observed between topotypes of *Geomys breviceps breviceps* and the population samples from the Brazos basin seemingly validate the naming of the latter as a new subspecies, for which I propose the name:

Geomys breviceps brazensis, new subspecies

Brazos Pocket Gopher

Type.—Female, adult, skin and skull; no. 537, Texas Cooperative Wildlife Research Museum; five miles east of Kurten, in Grimes County, Texas; collected February 20, 1938, by William B. Davis; original no. 2957.

TABLE I

External measurements (averages and extremes in millimeters) of Geomys from Mason and Llano counties, Texas

	TOTAL LENGTH	LENGTH OF TAIL	LENGTH OF HIND FOOT
♀ *llanensis* (9)*	232(224-240)	62(58-66)	29.5(29-30)
♀ *texensis* (8)	222(213-230)	62(58-70)	29.5(29-30)
♂ *llanensis* (8)	254(248-264)	70(64-74)	31.5(30-33)
♂ *texensis* (7)	258(243-272)	72(63-80)	33.0(31-35)

* Indicates number of adults averaged.

TABLE II

Selected Cranial Measurements (averages and extremes in millimeters) of Geomys from Mason and Llano counties, Texas

	texensis ♀	*llanensis* ♀	*texensis* ♂	*llanensis* ♂
Length of nasals	11.0(10.6-11.1)	12.5(11.4-13.6)	14.5(13.1-15.2)	15.1(14.4-16.0)
Breadth of rostrum	6.9(6.6-7.4)	7.7(7.3-8.0)	8.5(7.8-9.3)	8.8(8.3-9.6)
Breadth of rostrum / Length of nasals	62.5	61.5	58.5	58.2
Zygomatic breadth	21.1(20.5-22.5)	22.2(21.5-23.0)	25.7(24.4-27.5)	26.4(24.5-27.5)
Basilar length of Hensel	30.6(30.0-32.0)	32.0(30.4-33.4)	36.4(34.8-38.0)	35.9(34.8-37.7)
Zygomatic breadth / Basilar length of Hensel	69.0	69.3	70.5	73.5

Distribution.—In general, the drainage basin of the Brazos River from Fall County south to the Coastal Prairie.

Characters.—Size small (see measurements). Color: Winter pelage dark fuscous brown, median dorsal area near sooty; ventral coloration plumbeous, faintly tinged with fuscous. Summer pelage not so dark, more fuscous dorsally; sooty dorsal "stripe" evident; ventral portions more heavily washed with fuscous. Skull: Short and relatively broad; nasals averaging about 39 per cent of basilar length of Hensel; rostrum short and broad (ratio of breadth to length near 69); paroccipital processes well developed.

Comparisons.—Compared with *Geomys breviceps breviceps* (7 topotypes available): Rostrum much shorter and broader (ratio of breadth to length near 69, rather than near 60); paroccipital processes well developed, rather than poorly developed or nearly absent; premaxillae wider; maxillary arm of zygoma much heavier. Compared with *Geomys breviceps sagittalis* (topotypes): Averaging smaller throughout; rostrum shorter and relatively broader; auditory bullae much larger. Compared with *Geomys breviceps attwateri* (near topotypes): Smaller; premaxillae narrower. Compared with *Geomys breviceps llanensis* (topotypes): Much smaller; dorsal outline of skull flat or saddle shaped, rather than rounded.

Measurements.—Averages and extremes of five females: Total length, 205 mm. (192–216); length of tail, 62 (55–73); length of hind foot, 25 (24–27); basilar length of Hensel, 31.2 (29.6–32.4); zygomatic breadth, 23.8 (22.2–26.4); mastoidal breadth, 21.6 (20.5–23.4); length of nasals, 12.0 (11.4–12.6); breadth of rostrum, 8.8 (8.4–9.4); alveolar length of maxillary tooth row, 8.2 (7.8–8.2); palatofrontal depth, 13.9 (13.3–14.4).

Averages and extremes of five males: Total length, 234 (228–243); length of tail, 64 (60–70); length of hind foot, 29 (28–30); basilar length of Hensel, 36.0 (35.0–37.2); zygomatic breadth, 26.9 (26.2–27.5); mastoidal breadth, 23.7 (22.9–24.6); length of nasals, 15.1 (14.0–16.5); breadth of rostrum, 9.6 (9.2–10.1); alveolar length of maxillary tooth row, 8.7 (7.8–9.5); palatofrontal depth, 15.7 (14.9–16.7).

Remarks.—The specimens from Bastrop County average larger than those from near the type locality. Further collecting along the northern edge of the Coastal Prairie may reveal the presence there of an unnamed race of large pocket gophers.

Records of occurrence.—Specimens examined, 45 as follows: *Fall County*: 1 mi. S E Reagan, 1; 2 mi. N W Bremond, 1. *Robertson County*: 1 mi. W Bremond, 3. *Grimes County*: 5 mi. E Kurten, 3. *Brazos County*: 2 mi. S Bryan, 1; 23 mi. N E Bryan, 4; College Station, 5; 4–6 mi. S College Station 6; 3 mi. E Kurten, 2. *Walker County*: 6 mi. S Huntsville, 2; 17 mi. W N W Huntsville, 2. *Burleson County*: 17 mi. E Caldwell, 5. *Bastrop County*: 5 mi. E Bastrop, 6. *Leon County*: 13 mi. E Centerville, 4.

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NOTES ON THE VOLES OF THE MICROTUS LONGICAUDUS GROUP

By E. A. Goldman

In his "Revision of American Voles of the Genus Microtus" Bailey (North Amer. Fauna No. 17, p. 13, June 6, 1900) segregated, as the "*longicaudus* group," several forms typified by *Microtus longicaudus* (Merriam). Most of these, including true *longicaudus*, were treated as distinct species. Only two specimens from the type locality, Custer, South Dakota, and four from Sundance, in northeastern Wyoming were assigned to *longicaudus* while *Microtus mordax* (Merriam), represented by 708 specimens, was accorded a vast range extending through the Rocky Mountain region from New Mexico to Alaska and west to parts of the Pacific coast. The similarity of *mordax* to *longicaudus* was pointed out by Bailey, and the accumulation of much additional material since 1900 seems to warrant the treatment of a number of closely allied forms of the restricted group as geographic races of a single widely dispersed species. Many of these have been described as subspecies of *mordax*. The description of *Microtus coronarius* from Coronation Island, Alaska, indicates that this animal may belong here, but I have seen no specimens.

The subspecies of *Microtus longicaudus*, with type localities, may now stand as follows:

Microtus longicaudus longicaudus (Merriam).Custer, Black Hills (5,500 feet), South Dakota.

Microtus longicaudus mordax (Merriam).....Sawtooth (or Alturas) Lake (7,200 feet), east base of Sawtooth Mountains, Idaho.

Microtus longicaudus latus Hall.....Wisconsin Creek (8,500 feet), Toyabe Mountains, Nye County, Nevada.

Microtus longicaudus baileyi subsp. nov.....Greenland Spring, Kaibab Plateau, Arizona.

Microtus longicaudus alticola (Merriam).....Little Spring (8,200 feet), San Francisco Mountain, Arizona.

Microtus longicaudus leucophaeus (Allen).....Graham Mountains, Graham County, Arizona.

Microtus longicaudus littoralis Swarth.....Shakan, Prince of Wales Island, Alaska.

Microtus longicaudus macrurus Merriam.....Lake Cushman, Olympic Mountains, Washington.

Microtus longicaudus abditus A. B. Howell...Pleasant Valley, eight miles south of Tillamook, Oregon.

Microtus longicaudus angustus Hall.....Godman Spring (5,700 feet), Blue Mountains, Columbia County, Washington.

Microtus longicaudus angusticeps Bailey.....Crescent City, Del Norte County, California.

Microtus longicaudus sierrae Kellogg.....Tuolumne Meadows (8,600 feet), Yosemite National Park, Tuolumne County, California.

Microtus longicaudus bernardinus Merriam...Dry Lake (9,000 feet), San Bernardino Mountains, California.

Microtus longicaudus baileyi, subsp. nov.

Kaibab Meadow Mouse

Type.—From Greenland Spring, head of Bright Angel Creek, Grand Canyon National Park, Coconino County, Arizona (altitude 8,000 feet). No. 248924, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Vernon Bailey, July 13, 1929. Original number 10731.

Distribution.—Apparently restricted to the higher parts of the Kaibab Plateau, northern Arizona.

General characters.—A large, grayish brown form, most closely allied to *Microtus longicaudus latus* of the Toyabe Mountains, Nevada; size similar but color darker, the sides less extensively grayish; skull more massive. Differs from *Microtus longicaudus mordax*, of the Sawtooth Mountains, Idaho, in about the same characters as from *latus*, but to a greater degree, owing to the smaller size of *mordax*. Very similar in size to *Microtus longicaudus longicaudus* of southwestern South Dakota but color, especially of sides of body, more grayish; cranial details distinctive.

Color.—Type (summer pelage): Upper parts near "wood brown" (Ridgway, 1912), finely mixed on top of head and over back with black, becoming "smoke gray" along sides from cheeks to thighs; under parts grayish white; feet brownish gray; tail light brown above, grayish below. Some specimens in worn summer pelage are more or less distinctly reddish brown on the back.

Skull.—Similar in size to those of typical *longicaudus* and *latus*, but heavier than either; zygomata more widely spreading; rostrum and nasals broader; interorbital region broader; auditory bullae larger, more rounded and fully inflated; dentition heavier. Compared with that of *mordax* the skull differs in larger size and decidedly heavier proportions.

Measurements.—Type: Total length, 195 mm; tail vertebrae, 61; hind foot, 21. Average of four adult topotypes: 189 (185–198); 59 (55–64); 20.5 (20–21). *Skull* (type): Occipitonasal length, 29.3; zygomatic breadth, 16.4; interorbital constriction, 4; width across squamosals (at mastoids), 13.5; length of nasals, 8.8; upper molar toothrow, 7.

Remarks.—Microtus longicaudus baileyi is closely allied to the much more widely ranging subspecies *latus*, but is distinguished by darker color and differing combination of cranial details. It is about midway in color between *latus* and the dark, typical form *longicaudus*, which in turn is very similar to *latus* in cranial characters. Group material from southern Utah appears to be referable to *latus*.

Specimens examined.—Total number, 32, all from the Kaibab Plateau, Arizona, as follows: Big Springs (6,300–6,700 feet), 8; Bright Angel Spring, 5; Demotte Park (8,500 feet), 9; Grand Canyon (north rim), 2; Greenland Spring (type locality), 5; South Canyon (8,500 feet), 3.

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THREE NEW RACES OF MICROTUS MEXICANUS

By E. A. Goldman

The Biological Survey collection contains specimens of three forms of *Microtus mexicanus* that have not hitherto been recognized. I propose to name and describe them as follows:

Microtus mexicanus hualpaiensis, subsp. nov.

Hualpai Mountains Meadow Mouse

Type.—From Hualpai Peak, Hualpai Mountains, Mohave County, Arizona (altitude 8,400 feet). No. 244108, ♀ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by E. A. Goldman, October 1, 1923. Original number 23554.

Distribution.—Probably restricted to the upper slopes of the Hualpai Mountains.

General characters.—A small, light-colored form, closely allied to *Microtus mexicanus mogollonensis* of the Mogollon Plateau; size about the same but color paler, the upper parts in general suffused with lighter buff, and the back less heavily mixed with black; skull differing in detail.

Color.—*Type* (early winter pelage): Upper parts near "cinnamon-buff" (Ridgway, 1912), finely mixed with black, becoming paler on sides; under parts thinly overlaid with grayish buff, the dark under color showing through; feet grayish brown; tail dark brownish above, somewhat paler below.

Skull.—Closely resembling that of *mogollonensis*, but premaxillae reaching farther posteriorly beyond nasals; incisors rather broad, and molar toothrows slightly shorter than usual in *mogollonensis*.

Measurements.—*Type*: Total length, 134 mm.; tail vertebrae, 25; hind foot, 19. An adult male topotype: 134; 34; 20. *Skull* (young adult male topotype): Occipitonasal length, 24.6; zygomatic breadth, 14.5; interorbital constriction, 3.5; width across squamosals (at mastoids), 12; length of nasals, 7.2; upper molar toothrow (alveoli), 6.

Remarks.—The range of this mountain subspecies appears to be separated from that of *mogollonensis* by Lower Sonoran desert plains. It requires close comparison only with *mogollonensis*.

Specimens examined.—Four, all from near the summit of Hualpai Peak.

Microtus mexicanus madrensis, subsp. nov.

Sierra Madre Meadow Mouse

Type.—From Gavilan River, five miles west of Colonia Garcia, about 60 miles southwest of Casas Grandes, Chihuahua, Mexico (altitude 6,700 feet). No. 98172, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Nelson and Goldman, July 2, 1899. Original number 13870.

Distribution.—Sierra Madre of Chihuahua, and probably adjacent mountains of northeastern Sonora.

General characters.—A dark, richly-colored race of medium size, with slender skull. Most closely allied to *Microtus mexicanus phaeus*, of Jalisco, but more cinnamon brownish, the back more heavily overlaid with black; skull less massive and differing in detail. Similar in general to *Microtus mexicanus mogollonensis* of the Mogollon Plateau, Arizona, and to *Microtus mexicanus guadalupensis* of the Guadalupe Mountains, Texas, but larger, more cinnamon brownish than either, and cranial characters distinctive.

Color.—Type (summer pelage): Upper parts near "cinnamon-brown" (Ridgway, 1912), heavily mixed on top of head and back with black; under parts buffy gray; feet dark brown; tail dark brown above, lighter below. In some specimens the cinnamon-brown element is somewhat lighter in tone than the type.

Skull.—Similar in general size to that of *phaeus*, but less massive; rostrum and nasals longer and narrower, the nasals extending farther posteriorly beyond anterior plane of zygomata; premaxillae more prolonged posteriorly beyond ends of nasals; squamosal slits or openings over mastoids wider; auditory bullae smaller, less rounded and inflated; molars smaller, the toothrows narrower and shorter. Somewhat similar to that of *guadalupensis*, but larger, and differing otherwise in about the same characters as from *phaeus*. Compared with that of *mogollonensis* the skull differs most notably in larger size.

Measurements.—Type: Total length, 162 mm; tail vertebrae, 40; hind foot, 21. Average of six adult male topotypes: 151 (143–156); 38 (37–39); 20.2 (20–21). Average of seven adult female topotypes: 152 (142–160); 37 (33–43); 19.9 (19.5–20). *Skull* (type): Occipitonasal length, 28.1; zygomatic breadth, 16.8; interorbital constriction, 3.9; width across squamosals (at mastoids), 13.3; length of nasals, 8.5; upper molar toothrow (alveoli), 6.5.

Remarks.—Microtus mexicanus madrensis is a well-marked subspecies which probably ranges throughout the northern part of the Sierra Madre. Intergradation with *phaeus* is indicated by specimens from Durango which are referred to the latter form.

Specimens examined.—Total number, 43, all from Chihuahua, as follows: Colonia Garcia (type locality), 23; Sierra Madre, near Guadalupe y Calvo, 20.

Microtus mexicanus subsimus, subsp. nov.

Coahuila Meadow Mouse

Type.—From Sierra Guadalupe, southeastern Coahuila, Mexico. No. 116918, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by Nelson and Goldman, May 3, 1902. Original number 15195.

Distribution.—High, isolated mountain ranges from southeastern Coahuila to southwestern Tamaulipas.

General characters.—Size small; color cinnamon brownish; skull robust, with remarkably short rostrum. Closely allied to *Microtus mexicanus mexicanus* of the high plateau region of southern Mexico, but smaller; color slightly more rusty or cinnamon brownish; cranial details, especially shorter rostrum, distinctive. Similar to *Microtus mexicanus phaeus* of Jalisco, but smaller; color slightly lighter brownish; cranial features different. Closely resembling *Microtus mexicanus guadalupensis* of western Texas in color, and similar in size but skull heavier, with shorter rostrum. Compared with *Microtus mexicanus madrensis* of Chihuahua: Size smaller; color less rufescent; skull smaller and markedly different in detail.

Color.—Type (summer pelage): Upper parts between "cinnamon" and "sayal brown" (Ridgway, 1912), moderately mixed with black from top of head to rump; under parts buffy gray; feet grayish brown; tail dark brown above, grayish below to tip, which is dusky all around.

Skull.—Similar to that of *mexicanus*, but smaller; rostrum and nasals relatively shorter, the nasals more rapidly tapering and wedge-shaped posteriorly; interorbital region relatively broader; auditory bullae more truncate anteriorly, relatively larger, more rounded, and fully inflated; molar toothrows shorter. Compared with *phaeus*: Decidedly smaller; rostrum and nasals shorter; auditory bullae larger; molar toothrows shorter. Compared with *guadalupensis*: Size similar, but somewhat heavier; rostrum

shorter; nasals shorter, usually broader anteriorly, narrower and more wedge-shaped posteriorly; incisive foramina usually shorter; auditory bullae larger; dentition similar. Compared with *madrensis*: Decidedly smaller; rostrum and nasals much shorter and relatively heavier; nasals relatively broader anteriorly, more tapering and wedge-shaped posteriorly; auditory bullae relatively larger, more truncate anteriorly, more rounded and fully inflated; molar toothrows actually about the same, therefore relatively longer.

Measurements.—Type: Total length, 141 mm; tail vertebrae, 33; hind foot, 19. Average of ten adult topotypes: 138 (131–146); 31 (29–35); 19 (18.5–20). Average of eight female topotypes: 139 (134–144); 32 (31–34); 19 (18–20). *Skull* (type): Occipitonasal length, 24.5; zygomatic breadth, 14.9; interorbital constriction, 3.4; width across squamosals (at mastoids), 11.9; length of nasals, 7; upper molar toothrow (alveoli), 6.2.

Remarks.—Microtus mexicanus subsimus appears to be more nearly related to *mexicanus* than to any of the other known forms of the group. It is most readily distinguished by the shortness of the rostrum and nasals.

Specimens examined.—Total number, 45, as follows: Coahuila: Sierra Guadalupe (type locality), 25. Tamaulipas: Mountains near Miquihuana, 20.

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A NEW POCKET MOUSE FROM COLORADO

By E. A. Goldman

Specimens of pocket mice from the San Luis Valley, southern Colorado, and from parts of northern New Mexico, have been referred by authors to *Perognathus apache apache* or to *Perognathus apache melanotis*. Study of additional specimens of typical *apache* from the Painted Desert, Arizona, and review of the species as a whole bring into relief differential characters that seem to warrant the segregation of a new subspecies.

Perognathus apache relictus, subsp. nov.

San Luis Valley Pocket Mouse

Type.—From Medano Springs Ranch, 15 miles northeast of Mosca, San Luis Valley southern Colorado (altitude 7,600 feet). No. 150768, ♂ young adult, U. S. National Museum (Biological Survey collection); collected by Merritt Cary, November 2, 1907. Original number 1222.

Distribution.—San Luis Valley, Colorado, and high valleys of central-northern New Mexico, west to Lake Burford and south to the Upper Pecos River Valley; intergrading with typical *apache* in the Rio Grande Valley.

General characters.—Similar to *Perognathus apache apache* of the Painted Desert, Arizona, but upper parts in general darker buff and more profusely mixed with black; skull with smaller mastoid bullae. About the size of *Perognathus apache melanotis* from northwestern Chihuahua (of which only one specimen is known), and closely resembling it in color, but with higher, more arched cranium and larger mastoids.

Color.—Type (fresh pelage): Ground color of upper parts "pinkish buff" (Ridgway, 1912), deepest and purest along broad lateral line from cheeks to thighs, moderately lined or overlaid with black on top of head and over back; under parts white; a narrow indistinct buffy line along outer side of forearm; ears clothed with brownish hairs, and

with a small white spot at anterior base, as usual in the species; feet white; tail light brownish above, white below.

Skull.—Similar to that of *apache* but mastoid and auditory bullae smaller, the mastoids narrower, less distended, and less inclined to bulge above level of interparietal. Compared with that of *melanotis* the skull is broader; braincase higher, less flattened; interparietal longer, more nearly square, less rectangular in outline; mastoid bullae broader, deeper, more inflated; auditory bullae larger.

Measurements.—Type: Total length, 137 mm; tail vertebrae, 68; hind foot, 19. Two young adult male topotypes: 134, 139; 65, 70; 19, 20. *Skull* (type): Occipitonasal length, 22.7; mastoid breadth, 12.4; length of interparietal, 3; width of interparietal, 3.7; interorbital constriction, 5.5; length of nasals, 7.9; maxillary toothrow (alveoli), 3.2.

Remarks.—The new form, *relictus*, closely resembles *melanotis* in color, but the cranial details are quite different. Specimens from western New Mexico are referred to *apache*, but their darker color indicates gradation toward *relictus*.

Specimens examined.—Total number, 26, as follows: Colorado: Medano Springs Ranch (type locality 15 miles northeast of Mosca), 3. New Mexico: Glorieta, 2; Gran Quivira, 1; Lake Burford, 2; Pecos (3 miles south), 17; Santa Fe, 1.

Biological Survey, U. S. Dept. of Agriculture, Washington, D. C.

A NEW PYGMY FRUIT BAT FROM BORNEO

By Glover M. Allen

In the collection of small mammals lately brought back from Borneo by the Harvard Primate Expedition under the leadership of Mr. Harold J. Coolidge, Jr., are four examples of a pygmy fruit bat of the genus *Aethalops*, collected by Mr. J. Augustus Griswold, Jr., at a camp on the middle levels of Mt. Kinabalu, the high peak of British North Borneo. This genus was unknown to Andersen when he wrote his monograph on the Pteropidae in 1912, for it was not discovered until 1923, when Oldfield Thomas (Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 251, Feb. 1923) first described as *Aethalodes alecto* a specimen from Indrapura Peak, Sumatra, at 7300 feet altitude. The generic term, however, proved to be preoccupied, so that Thomas shortly afterward proposed as a substitute, *Aethalops* (Abstr. Proc. Zool. Soc. London, no. 235, p. 14, Feb. 6, 1923). With a forearm of slightly less than 50 mm., this is one of the smallest of the Old World fruit bats. Externally it is characterized by the absence of the tail, the minute calcar, the very narrow interfemoral membrane, which is abundantly hairy, both above and below, and by the rather small ears. The skull shows that it belongs to the Cynopterine section and is closely related to the genera *Balionycteris* and *Chironax*, as well as to the larger *Penthetor*, in all of which the usual perforation of the postorbital processes is lacking, the lower incisors tend to be reduced (only two in *Balionycteris* and *Penthetor*) while the upper incisors are slender and four in number, the two outer teeth shorter and more slender than the two

inner. In *Aethalops*, on the other hand, the two outer upper incisors are stouter than the inner pair. According to Thomas, the inner pair in his Sumatran specimen is shorter than the outer, but in the specimens now available from Borneo, the inner upper pair of incisors though slenderer, is of equal length with the outer in each of the 3 skulls. This difference may be better regarded therefore as a specific rather than a generic character. To emphasize this point, the Bornean bat may be named

Aethalops aequalis sp. nov.

Type.—An adult female skin and skeleton, no. 36582, Museum of Comparative Zoölogy, from Lumu Lumu, Mt. Kinabalu, British North Borneo, altitude 5500 feet; collected July 12, 1937, by J. Augustus Griswold, Jr.

Diagnosis.—A small fruit bat with thickly furred hind legs and whitish hind claws. Differs notably from the Sumatran *Aethalops alecto* in that the inner upper incisors are as long as the outer instead of shorter.

Color.—Crown and cheeks dark, near fuscous; shoulder region and entire central area of the back, to the rump, with the hairs 'mouse gray' at the base tipped with dark brown (about 'Mars brown' of Ridgway). Upper half of the forearm, the humerus, and a strip along the sides of the body extending posteriorly to include the rump, the entire upper side of hind leg to the base of the claws, and the interfemoral membrane, a clearer dull 'russet' to 'cinnamon brown', setting off rather distinctly the central dark area of the back. Extreme base of the ears posteriorly 'cinnamon brown'. Under surface with a nearly similar distribution of color but paler; chin and upper throat thinly haired, pale fuscous, the chest and upper abdomen with the hairs pale mouse gray at base, tipped minutely with cinnamon brown, which becomes more extensive and clearer on the hairs at the sides of the body, limbs, and interfemoral region, but is distinctly less brown than the corresponding area on the dorsal side. The wing membranes are uniformly blackish brown, without trace of pale spots such as occur in *Balionycteris*, and in the Sumatran *Aethalops alecto*. In none of the four skins is any trace of the calcar detectable externally, while the interfemoral membrane is reduced to a mere ridge. The wing membrane arises from the metatarsus between the bases of the first and second toes. On the upper side the fur extends out on the wing membrane as far as a line joining the elbow and the knee, but on the under surface it does not extend quite so far. The claws are whitish.

In the skull the posterior part is so little deflected that the alveolar line, if projected backward, about passes through the lower part of the occipital condyle. In profile, the upper outline of the rostrum is slightly but evenly sloped downward, as in *Balionycteris*. The postorbital processes, however, are blunter, without the attenuated points of the latter. Like it, they are quite without perforation. The weak temporal ridges do not meet to form a crest in either of the two older specimens. The dentition is: i. $\frac{2}{3}$ c. $\frac{1}{1}$ pm. $\frac{3}{3}$ m. $\frac{3}{3} = 28$. The genus differs from the related pygmy fruit bats such as *Balionycteris*, *Chironax* and *Penthetor* in that the upper incisors, instead of having the outer pair shorter and slenderer than the inner, have reversed this tendency, so that the inner pair is slenderer and of about one half the cross-section of the outer. All are cylindrical slender spicules with bluntly rounded crowns, showing no tendency to the formation of a cutting edge. Thomas expressly states that in the type of *Aethalops alecto*, the inner upper incisors are "considerably shorter" than the outer; but in the Bornean species they are distinctly of equal length. The first upper premolar is minute, stands in the center of the short space separating the canine and the second large premolar, and has the anterior portion of its crown projecting distinctly forward.

The second upper premolar is the largest of the cheek teeth, with the main cusp occupying the outer half of the tooth, and prolonged anteriorly to form a blunt secondary cusp, rather indistinctly marked off. The last premolar in the upper jaw is lower and lacks an antero-external cusp, but in crown view is narrower, nearly a rectangle with rounded corners. The upper molar is situated just anterior to the edge of the orbital fossa and resembles in outline the last premolar, except that it is slightly narrowed posteriorly. Each of the two lower incisors has a minute angular notch on the outer side of the crown, which is slightly trenchant with blunt chisel-edge. The canine is stout in front view, about twice as high as the incisor, and faintly grooved on the inner side opposite the incisor. In side view it appears more slender, with a minute posterior cingulum ridge. The first lower premolar is about a third smaller than a lower incisor, but of nearly the same shape, with the posterior half of its crown notched. The third lower premolar is much like the second, but smaller and lower in profile, though of nearly the same elliptical section in crown view, minutely narrower anteriorly. In each, the main cusp is at the antero-external corner. The two molars following are each successively smaller as viewed from above, nearly oval in outline, with the anterior end very slightly the wider, and with nearly flat crowns.

The skeleton shows twelve pairs of ribs of which the anterior seven articulate with the sternum, by means of their ossified false ribs. The tail vertebrae do not extend beyond the ischia.

Measurements.—The flesh measurements as recorded by the collector, and those of fore arm and lower leg of the type and two other adults (in order) are as follows: Length of head and body, 70, 65, 63 mm.; tail, 0; hind foot, 11, 10, 10; ear, 10, 11, 10; forearm, 45.5, 45.5; 43.0; lower leg and foot 25, 24, —.

The skull of the type measures: Greatest length, 22.7 mm.; basal length, 20.5; palatal length, 11 6; zygomatic width, 15.0; mastoid width, 10.3; width outside molars, 7.0; upper cheek teeth, 7.3; lower cheek teeth, 8.5; length of mandible, 17.0.

Remarks.—The discovery of this genus in Borneo, though not unexpected, is nevertheless one of the interesting results of the expedition. Since the only other known specimen came from 7300 feet altitude in Sumatra, it may be concluded that it is characteristic of the upland forests, for all four of Mr. Griswold's specimens were taken at 5500 feet on Mt. Kinabalu. It is interesting that all were secured one at a time at intervals of several days in a large bird-net erected in the forest. This net the small insectivorous bats succeeded in avoiding, doubtless because their more alert senses of sight and hearing warn them in time of the obstruction, but the heavy-bodied fruit bats of this smaller type were less skillful. The first specimen, taken June 21, is immature and in color is nearly uniform fuscous, slightly blacker on the forehead, and with only a faint suggestion of the russet lateral border and interfemoral area of the adults. The latter were taken on July 12, 16, and 23, respectively.

Thomas described the Sumatran species as "dark smoky blackish", but since his specimen was preserved in alcohol, too much reliance can not be placed in its appearance; nor is there any evidence in our Bornean skins of the "inconspicuous lighter spots" on the wings which are mentioned in his account. The forearm of the Sumatran specimen is said to be 48 mm., so that it is apparently a very slightly larger animal. In view of these differences and the equality instead of disparity in length of the upper incisors, I have regarded the Bornean bat as a distinct species, notwithstanding that it undoubtedly is the representative of *A. alecto* in that island.

Museum of Comparative Zoology, Harvard College, Cambridge, Mass.

GENERAL NOTES

VIRGINIA OPOSSUM IN VERMONT

A mature male Virginia opossum, *Didelphis virginiana virginiana*, was taken by John Morrissey of Bellows Falls, Vermont. This is the second record for the state. The first was taken at Bennington during the summer of 1936.

Bellows Falls is in the valley of the Connecticut River, approximately 30 miles north of the Vermont-Massachusetts boundary.—GEORGE W. DAVIS, *Fish and Game Service, Montpelier, Vermont.*

AN OPOSSUM IN NEW YORK STATE FEELS THE EFFECTS OF WINTER

During the evening of January 30, 1938, a noise was heard at the bird-feeding shelf outside our sitting room window at Mohonk Lake, N. Y. Investigation showed a nearly full grown opossum eating a lamb kidney and its suet. Closer observation with a flashlight on subsequent evenings showed that both the ears and tail were injured. Evidently the end segment of its tail had been lost and one vertebra showed beyond an area of raw flesh. The tips of both ears were missing also. The top edges were raw flesh and nearly a half inch of the outer ends of the ears were discolored. Apparently the flesh of both ears and tail was sloughing off. This animal was last seen during the last week of February, at which time the injured extremities still seemed to be in a raw state. Probably they had been frozen in the cold weather (down to 10 below Zero), which we had had during January.

Anthony gives the range of *Didelphis v. virginiana* as from "the Hudson valley to northern Texas," etc. Mohonk Lake is in the Shawangunk Mountains at the edge of the Hudson Valley, 75 miles north of New York City, at an elevation of 1250 feet.—DANIEL SMILEY, JR., *Mohonk Lake, Ulster Co., New York.*

A HEAVY CONCENTRATION OF CRYPTOTIS

If we accept the principle proposed by McAtee (Smithsonian Misc. Coll., vol. 85, 1932) that "predation . . . tends to be in proportion to population", it follows that tabulation of items found in owl pellets may constitute a rough index of relative abundance of the species concerned. I hasten to point out, however, that one must take into consideration the preferences of the predator and the habits and size of the prey. It would be folly, for instance, to infer from a pellet analysis that revealed one pocket gopher and twenty cotton rats that the rats were twenty times as abundant as pocket gophers. The habits of the two differ so greatly that their relative ease of capture would not be the same. If we compare two species that are within the range of size easily handled by the predator, and whose general habits are similar, the results should be roughly comparable.

Of particular interest in this connection are some data obtained from dejecta collected by Walter P. Taylor and Valgene Lehmann, of the Texas Cooperative Wildlife Research Unit, at the roost of a pair of barn owls in Colorado County, Texas. The pellets were disintegrated, so their number could not be determined. Analysis of the remains revealed the following: *Cryptotis parva*, 171; *Reithrodontomys fulvescens*, 101; *Sigmodon hispidus*, 35; *Peromyscus leucopus*, 27; *Oryzomys palustris*, 13; *Mus musculus*, 10; *Sylvilagus floridanus* (young), 4; *Geomys breviceps*, 3; *Rattus rattus*, 3; *Scalopus aquaticus*, 1; *Didelphis virginiana*, 1; snakes, 13; birds 14, and a number of invertebrates, chiefly *Coleoptera*, and *Orthoptera*. The invertebrates comprised an estimated 10 per cent of the total.

Considering only the mammals that inhabit the surface of the ground, we find that *Cryptotis parva* comprised 41 per cent of the total number of mammals taken. This

is indeed surprising, for it is common knowledge that shrews usually constitute a very small part of the diet of owls. Does this figure indicate an appetite on the part of these owls for shrews, or, rather, does it indicate a high population of shrews per unit area as compared with other small mammals? Although I have not checked by trapping, I am inclined to the latter view. At any rate, these data disprove the idea that owls (at least these barn owls) dislike the taste of shrews. Perhaps the relative scarcity of shrew remains reported from other regions signifies a low relative abundance of shrews as compared with other small mammals. The ratio of *Reithrodontomys* to *Sigmodon*, to *Peromyscus*, to *Perognathus* in this detritus is very close to that found at College Station, about 100 miles to the north, where sampling has been done by trapping methods.—WILLIAM B. DAVIS, *Department of Wild Game, Agricultural and Mechanical College of Texas, College Station, Texas.*

A SECOND RECORD OF TADARIDA MACROTIS FROM UTAH

While we were recently examining the bats in the mammal collection at the University of Utah we found a specimen of *Tadarida macrotis* taken not only at the same locality as the one recently reported by Woodbury (Jour. Mamm., vol. 18, p. 515, 1937) but also in front of the very same building. However, an interval of three years almost to the day had elapsed between the finding of the two specimens.

This second specimen, a male, no. 425, Museum of Zoology, University of Utah, was collected by S. D. Durrant at the Zion Park Lodge, Zion National Park, Utah, August 19, 1931. It conforms in all respects to the characters given for the species by Shamel (Proc. U. S. Nat. Mus., vol. 78, pp. 1-27, 1931) and the identity of the specimen has been checked by Dr. E. Raymond Hall. The fact of the occurrence of the species at the same locality on two separate occasions is suggestive that the species may not be so uncommon in southern Utah as heretofore supposed.—STEPHEN D. DURRANT and WILLIAM H. BEHLE *Department of Zoology, University of Utah, Salt Lake City, Utah.*

NOTES ON HIBERNATING BATS

During December, 1937, a rather large series of hibernating bats, *Myotis velifer incautus* and *Corynorhinus rafinesquii pallescens*, was collected by Dr. A. B. Leonard in Blaine County, Oklahoma. Analysis of the stomach contents of these specimens disclosed in many individuals a mass of hair-like fibers, which proved upon examination to be the barbed hairs of the bats themselves. Hair from both *Myotis* and *Corynorhinus* was represented in stomach contents of individuals of both species. In the series of 57 *M. v. incautus*, 29 stomachs were at least half full of the hair, while 28 contained little or no hair. Of 8 stomachs of *C. r. pallescens* 4 were at least half full and 4 were nearly empty.

These bats were collected from the walls and ceilings of low caves while hanging in close proximity to one another. The presence of the hair in the stomachs of the bats is somewhat puzzling. The week of December 22-30, in which the collecting was done, was very mild and the bats were somewhat active. It is possible, inasmuch as both species were heavily parasitized with bat-flies (Streblidae) and mites, that the bats, being aroused by the warm weather, undertook to feed upon the parasites of one another and in doing so, also consumed quantities of hair. Insect remains in the stomachs were confined to a few antennae.—JAMES M. SPRAGUE, *Museum of Birds and Mammals, Lawrence, Kansas.*

A RECORD OF THE JAGUARUNDI IN ARIZONA

Observation of a jaguarundi (*Felis yagouaroundi tolteca* Thomas) in southern Arizona may be worthy of record, as the range of this species in the United States, as given

in references, is confined to the Rio Grande valley of extreme southern Texas. This species is not included in the list of large predator animals of Arizona by A. A. Nichol in "Arizona and Its Heritage" (Univ. Ariz. Bull. 7 (3): 70–74, 1936).

On March 17, 1938, George S. Meagher and I saw a catlike mammal, which was later identified as an adult jaguarundi, about 3 miles east of Canelo Ranger Station on the Coronado National Forest, in Sec. 1, T. 22 S., R. 18 E., Santa Cruz County, Arizona. The location is only about 15 miles north of the Mexican border and is in rolling foothills at an elevation of about 5,000 feet, near the north end of Huachuca Mountains, which rise to a maximum elevation of 8,400 feet a few miles to the southeast. Vegetation where the jaguarundi was seen is semi-desert grassland with scattered Emory oaks. The animal came into sight from the southeast. It crossed an arroyo and went to a small knoll at a distance measured afterwards as 150 feet east of the truck near which we were standing. It was 9:30 A.M., a clear day, and a breeze was blowing from the south. The animal apparently did not see us. We watched it for about a minute while it walked around on the knoll only 150 feet away, recrossed the arroyo, and disappeared over the ridge to the south from which it had come. While on the knoll the jaguarundi was in plain view with no trees or other vegetation to hide it from us. The short distance and unobstructed view made possible accurate observation of the animal's features for identification.—ELBERT L. LITTLE, JR., *Southwestern Forest and Range Experiment Station, Tucson, Arizona.*

NOTES ON THE BLACK BEAR IN NEW YORK STATE

The date at which the black bear begins its period of hibernation depends apparently upon a number of factors, one of which seems to be temperature. During the month of October, the weather in some parts of the Adirondack Mountains is usually not severe and on October 13, 1930, when the thermometer registered 80 degrees F., I observed fresh tracks of two bears near Brant Lake. Throughout November the temperature may be low, although the cold is usually not intense and bears normally remain active. On November 2, 1927, D. L. Briggs killed a male near the village of Adirondack, and on November 11, 1928, I observed a black bear near Cedar River Flow. A number of bears are killed every hunting season between October 15 and November 15.

Late November and the first week in December seems to be the time when the black bear begins its long winter sleep in New York State, and I have never found fresh tracks of bear after December 1.

Ray Smith located bears in hibernation, December 1, 1932, near Phoenicia, New York, and his dog has on a number of occasions aroused and chased bears from their dens during January and February. Some of these were shot by Mr. Smith and found to be nursing females.

On December 15, 1935, Game Protector Francis Du Cuennois tracked a black bear to its hibernating quarters—a rocky porcupine den on the south side of a spruce-clad mountain near Tennant Lake, Saratoga County. He visited the cave frequently throughout the winter and observed that the bear did not emerge until March 12, 1936.

An infant black bear, that I examined, was taken by Ray Smith near Phoenicia on February 12, 1933. On that date the animal was covered with blue-black fuzz, plastered so close to the body that it appeared as bare wrinkled skin. The underside was naked and the soles of the feet and the nose were flesh pink. Its eyes were closed and the ears were pressed tightly to the head. The creature was 6 inches long and weighed 6 ounces.

On February 25, it weighed 12 ounces and on March 9, 14 ounces. One eye opened on March 12; the other on March 13. On March 16, short black hair covered its body and the ears were well developed but scantily haired. Its weight on March 27 was 20 ounces. The only sound the infant produced was a rather loud whimpering whine.

Assuming that the eyes open at the age of 40 days, it seems that this young one was born about February 1, 1933. Also it is possible that the weight would have been greater on March 27 if the infant had been nursed by its mother.

The den in which this infant was found was near the top of Cross Mountain, on the north side, in a dense thicket of yellow birch, hemlock, wild cherry and striped maple. I examined the den and found that it was located under one of a group of large boulders, and measured on the inside 6 feet wide, 5 feet deep, and 18 inches high, while the triangular entrance was only 12 inches high and 19 inches wide at the base. The nest was constructed of dry leaves, hemlock boughs, lichens, and twigs.

Two or three young seem to be the usual number in a litter and the individual described above was one of two produced by a female weighing 156 pounds. Three cubs were taken from a den near Phoenicia by P. O. Krom on February 22, 1933, and the next day the mother, which weighed 203 pounds, was killed. John Taylor took three cubs, which weighed 6 pounds each, in Lewis County on April 4, 1906; Walter Fraser took one cub weighing 30 pounds near Allaben in August, 1902; and James Armstrong observed two cubs with their mother in late spring, 1930, near Minerva.

In Alleghany State Park, 1926, unmolested black bears were active throughout the day and were rather frequently disturbed while feeding. Near Minerva, 1936, where bears were hunted, the animals were quite wary. Several individuals, which fed upon apples in old orchards near my camp, appeared only after dark and were gone before the following morning.

During the last week of May, 1934, G. L. Hooley of Albany was fishing for trout in the northwest corner of Essex County. Numerous tracks along Moose Creek and in the swamps suggested unusual activities among the bears. Quietly the fisherman approached Grassy Pond and had the unusual opportunity of observing 6 black bears only about 100 feet from the edge of the water. These made off when the fisherman approached. I believe that these animals were associated for the purpose of mating, although no direct observations on the act were made by Mr. Hooley.—W. J. Schoonmaker, *New York State Museum, Albany, New York.*

CONCESSION FOR ELEPHANT SEAL TAKING IN KERGUELEN AND OTHER ISLANDS

Word received from the American Consul at Paris, France, under date of March 4, 1938, states that a 30-year concession permitting the fishing and hunting of elephant seals in the Kerguelen, Crozet, and Amsterdam islands expired in 1937, but that a tentative proposal has been drawn up for its renewal.

"The islands mentioned are located in the southern Indian Ocean, at a considerable distance from, but under the jurisdiction of, Madagascar. The Kerguelen group consists of some hundred small islands, lying at about 49 degrees south latitude, and 66 to 68 degrees east longitude, with a total area of about 1,000 square miles. The Crozet Islands, in south latitude 45° 30′, and 47° 51′ east longitude, consist of an eastern group (Iles de la Possession, Iles de l'Est, Hog Island) and a western group (Iles Marion and Prince Edward Island). Amsterdam Island is located at 37° 50′ south latitude and 75° 6′ east longitude.

"The holders of the previous concession were a Mr. Rene E. Bossiere and his brother, who according to a letter from Consul Samuel H. Wiley at Havre, have every reason to believe that they will again be awarded the concession.

"The concession embraces three things, the right to hunt and fish elephant seals in the Crozet and Kerguelen archipelagos and their territorial waters, the right to establish in these islands plants for the fabrication of oil from these animals, and the right to engage in sheep raising in the same islands, also including Amsterdam Island. These rights are to be exclusive for a period of thirty years.

"Climatic conditions are said to be quite similar to those of the Falkland Islands where sheep raising is a profitable pursuit.

"Other types of fishing and the right to fish-drying establishments on the islands are not included in the exclusive contract and are left to all French nationals or subjects. Also not included are rights to exploit mines or quarries, which may be granted to third parties at any time. Travellers are said to have observed deposits of coal in the Kerguelens.

"According to the terms of the contract the Colony of Madagascar would receive an annual payment of 25,000 francs as well as certain shares in the profits."—HARTLEY H. T. JACKSON, *U. S. Biological Survey, Washington, D. C.*

THE FISHER CHIPMUNK IN MASSACHUSETTS

During the course of field work in New England, I noticed that specimens of *Tamias striatus* occuring on the coastal plain of Massachusetts were noticeably darker than specimens of *lysteri* obtained in New Hampshire.

A series of specimens from eastern Massachusetts was assembled and compared with topotypes of *lysteri* and *fisheri* and they were found to resemble more closely the latter subspecies. Two specimens from Fall River, Massachusetts, in the Biological Survey Collection at Washington have been referred to *fisheri* by A. H. Howell and specimens which I examined from Wilmington, Burlington, and Topsfield are of the same race.

The northern extent of this race in New England would appear to be near the northern border of Massachusetts and in the coastal plain region. On the interior highlands, *lysteri* occurs in more or less typical form.—NORMAN A. PREBLE, *Columbus, Ohio.*

ATTWATER'S WOOD RAT IN MISSOURI

Goldman, in his revision of the wood rats (North Amer. Fauna, no. 31, p. 26) recorded specimens of *Neotoma floridana attwateri* from Marble Cave, Stone County, Missouri.

The writer found this subspecies during March and April, 1938, at Hahatonka, Camden County, and Bennett Spring State Park, Laclede County, Missouri, places that are considerably north of Marble Cave. The animals were inhabiting water-worn cavities in the face of limestone bluffs bordering small streams.

The specimens were identified at the Field Museum through the courtesy of the Director, Dr. C. C. Gregg. One is now in the Field Museum collection, another in the collection of the University of Missouri.—GEORGE E. MOORE, *Lebanon, Missouri.*

THE PRAIRIE WHITE-FOOTED MOUSE IN NEW YORK STATE

During the course of some random trapping on the Moulthrop farm at Elba, Genesee County, New York, I took two specimens of *Peromyscus maniculatus bairdi* (Hoy and Kennicott) from a trapline set in the center of a large open field. One was trapped on April 12, 1938, and the second on April 14, 1938, at least one hundred yards away from the first. No other trapping was attempted in possible *bairdi* territory, but it seems probable that *Peromyscus maniculatus bairdi* occurs in most of the large open fields in this vicinity.

The specimens are now skins nos. 12699 and 12700 in the mammal collection of the Cleveland Museum of Natural History. I believe this constitutes a new record for New York State.—PHILIP N. MOULTHROP, *Cleveland Museum of Natural History, Cleveland, Ohio.*

NOTES ON THE WHITETAIL DEER IN NEW YORK STATE

Northeast of Malden Bridge, Columbia County, New York, is a triangular area about one mile by three-quarters of a mile, bounded on all sides by roads. Here, rather well

concealed in the forest, the writer has a cabin and, because of frequent visits in both winter and summer, he has been able to make many observations on the animals of the area. The following notes deal with the white-tailed deer (*Odocoileus virginianus borealis*).

Home range.—In the fall of 1929 a buck and a doe deer were observed in the locality and throughout the winter their tracks were often seen and followed. Never, so far as I could see, did the animals cross the road, and most of the time they did not wander more than one-quarter of a mile in any direction from a small knoll upon which they frequently slept.

In 1930, a single fawn was born and its dainty tracks, with those of the mother's, dimpled the forest floor in the same restricted area. At no time throughout the summer was the buck seen with the mother and young, although he remained in the same area. Tracks in the December snow proved that the entire family was then united, and three beds, one small and two large, were found together and very often on what may be termed the favored knoll.

No evidence of the birth of fawns was noted in 1931, and the tracks of only two large animals were observed during that winter.

In 1932, two fawns appeared with the female, and during the warm days of early autumn the buck joined the band and the family remained intact throughout the winter.

Further detailed observations were not made until the autumn of 1935, at which time the deer were being harassed by hunters and often sought shelter, during the day, in a small, wet, and dense swamp about one-half mile from the favored sleeping knoll. Only a buck—an eight-pointer—and a doe were seen during this period.

In 1936, twin fawns were produced and the family of four deer was observed together late in the summer of the same year. Observations on the animals were not made again until November, 1937 (the hunting season), when only a doe and a fawn were observed in hiding in a thick stand of small white pines. Later in the same month, E. A. Ramella disturbed the two deer, which fled across a low open hill and into a swamp about one-quarter of a mile distant. Three rifle shots rang out but whether or not the deer were killed was not determined. In January, 1938, I thoroughly covered the area and found no tracks of deer in the snow, although tracks of a number of large dogs were observed, and these animals may have driven the deer away.

So far as I was able to determine, the original pair of adults did not go outside of the triangular area heretofore described.

Other observations that tend to establish the home range of the whitetail are hereby briefly summarized. Of 7 wounded deer, 2 were killed about one-half mile from the point of first encounter about two weeks after being wounded; one was taken one-quarter of a mile away about one month later; three, less than one-half mile distant about one year later, and one about 75 feet away, two years later.

The home range of the whitetail is evidently small, and under normal conditions seems to be not greater than one-half mile square. However, certain factors may influence the activities of the deer. A buck in quest of a mate may travel far during the rutting season, and when persistently hunted the animal is apt to go beyond the limits of the home range. Also when wounded and tracked by hunters and when trailed by dogs the deer may leave its territory, but barring death or accident it usually returns.

Sex relations.—According to my observations, the buck whitetail does not herd together a number of does. Never, have I seen more than one adult doe with an adult buck during the mating time. At this season, however, as many as three deer without antlers have been observed in company with one buck, but these were always an adult doe and her two fawns, and this combination is not unusual.

Abundance.—In their hunting lodge near Harrisburg, Fred Streever and two other

guides entertained 66 hunters during the season of 1917. Forty-two deer were killed, including adult bucks, does, and fawns. From this same camp 35 to 60 deer were killed annually over a seventeen-year period from 1906 to 1922. Records kept by Fred Streever show that only one adult buck was killed for every seven does and fawns. From my experience this might be expected because the adult buck is a very wary and woods-wise creature. These numbers of deer may seem unusual; yet hunters work three or four miles in all directions from their camp and therefore hunt over an area of, let us say, 36 square miles. Only one or two deer, then, are killed for each square mile hunted over.—W. J. SCHOONMAKER, *New York State Museum, Albany, New York.*

NOTES ON THE MAMMALS OF GALVESTON AND MUSTANG ISLANDS, TEXAS

Comparison of the rodent fauna of two Texas coastal islands, Galveston Island and Mustang Island, apparently involves the successful occupation of the latter by the exotic forms, *Rattus norvegicus* and *Mus musculus musculus*.

These two islands, near the opposite ends of a string of coastal islands extending from Galveston Bay southwestward to the mouth of the Rio Grande, are similar in that they are barrier islands. Galveston Island, on which is situated the seaport of Galveston, is 30 miles long. Mustang Island, with the seaport of Port Aransas directly east of Corpus Christi, is about 18 miles long. It is now joined to Padre Island to the south by the filling up of an inlet during a recent West Indian hurricane.

Using Schuyler rat and mouse traps, the catch in 150 trap nights in January, 1938, on Galveston Island, at points 4 and 15 miles respectively west of Galveston, was 12 *Mus musculus musculus*, 10 *Rattus norvegicus*, and 4 *Sigmodon hispidus texianus*. The house mice were found in sandy soil in fields one mile or more from the nearest house. Colonies of their small burrows were found under piles of drift logs and clumps of cactus. The Norway rats were found closer to houses in sedges and small thickets where distinct runways were noted.

On Mustang Island, 18 miles south of Port Aransas, the catch in 100 museum style mouse traps set for one night in April, 1938, was 40 *Dipodomys compactus* and 12 *Onychomys leucogaster longipes*. These traps were examined four times during the night, however. Nine *Geomys personatus personatus* and 4 *Citellus spilosoma annectens* were collected in steel traps at the same locality. *Dipodomys* were exceedingly abundant. The grasshopper mouse, *Onychomys*, and the Mexican badger, *Taxidea taxus berlandieri*, are new records for the island. One badger was observed.

The cotton rat, *Sigmodon*, seems to be the only native rodent on Galveston Island. The exotic rat and mouse, introduced presumably by ships visiting the port, have thoroughly established themselves on the island regardless of whatever competition was offered by native species. Very likely, prior to the appearance of these rodents, other native forms existed but have been exterminated by competition with the exotic forms.

Port Aransas on Mustang Island has been a seaport for only about the past 15 years, whereas Galveston has been a port for well over a century. Control measures, directed toward rats and mice involved in the spread of bubonic plague, probably have kept the rat and mouse population at Port Aransas low. Apparently these circumstances have not given the Old World rodents the same opportunity to populate Mustang Island as they have had on Galveston Island. Furthermore, little or no permanent fresh water occurs on Mustang Island because of limited rainfall. This fact is the apparent cause in keeping the house mouse and Norway rat from spreading over the island. At Galveston Island a greater rainfall, yielding a fair supply of fresh water, encourages the increase and spread of the exotic rodents.—ROLLIN H. BAKER AND DANIEL W. LAY, *Agricultural and Mechanical College of Texas, College Station, Texas.*

TWENTIETH ANNUAL MEETING OF THE AMERICAN SOCIETY OF MAMMALOGISTS

The twentieth annual meeting of the American Society of Mammalogists was held at the Life Sciences Building, University of California, Berkeley, from July 19 to 23, 1938. There were 114 members present, representing 16 states, the District of Columbia, one Canadian province, Australia, Brazil, Denmark, France, and Sweden.

PROGRAM

TUESDAY, JULY 19

9:00 *p.m.*

Meeting of the Board of Directors at Hotel Durant

WEDNESDAY, JULY 20

10:25 *a.m.*

1. Address of welcome. Monroe E. Deutsch, Provost, University of California.
2. Responses by sectional delegates from abroad and the eastern United States.
3. The mammal collection of the National Museum of Canada. R. M. Anderson, National Museum of Canada.
4. Remarks on nomenclature and allied matters. W. H. Osgood.
5. L'introduction et l'implantation en France de Mammifères Americains (*Myopotamus* ou *Myocastor coypus* Molina, et *Fiber zibethicus* L.) dans la Période contemporaine. E. Bourdelle. Paris. (Read by Paul Rode).
6. Some notes on mammals of Arizona. Charles T. Vorhies, University of Arizona.
7. Some observations and comments on mammals of Louisiana. George H. Lowery, Jr., University of Louisiana.

2:15 *p.m.*

Annual Business Meeting of the Society

4:00 *p.m.*

8. The importance of a thorough life history knowledge before undertaking control measures of wild mammals. William T. Shaw, Fresno State College. Slides.
9. Alien mammals in California. Tracy I. Storer, University of California. Slides.
10. Determinants of life patterns. Mary Louise Fossler, University of Southern California. (Read by title).
11. A comparative study of some vital internal organs of mammals and birds. Mabel Fossler, Pasadena, California. (Read by title).

7:00 *p.m.*

Members of the Society, their wives and friends were entertained at an open house and buffet supper in the specimen gallery of the Museum of Vertebrate Zoology, University of California.

THURSDAY, JULY 21

9:00 *a.m.*

12. A skull of *Bison latifrons* from the Pleistocene of California. V. L. VanderHoof, University of California.
13. Considérations sur la systematique des Simiens africains. P. Rode, Muséum National d'Histoire Naturelle, Paris. Slides.
14. The significance of geographic variation with respect to size of ears and auditory bullae among certain species of rabbits in California. Robert T. Orr, California Academy of Sciences.

15. The mammals of Greenland, with special reference to zoogeography. Magnus Degerbøl, Universitets Zoologiske Museum, København, Denmark. Slides.
16. The significance of Tertiary mammalian faunas in Holarctic correlation. R. A. Stirton, University of California.
17. Remarks on the extinct vertebrates of the Tabin-Buluk area of China. Birger Bohlin, Palaeontological Institute, Upsala, Sweden.
18. Recapitulation and the opossum hand. Berry Campbell, Oklahoma Medical School. Blackboard.
19. The skull of *Osteoborus validus* from the early Middle Pliocene of Texas. C. Stuart Johnston, West Texas State Teachers College. (Read by title).
20. Motion pictures of Greenland. Magnus Degerbøl, Universitetets Zoologiske Museum, København, Denmark.
21. Motion pictures of marine mammals in the Santa Barbara Channel, California. J. R. Pemberton (shown by A. B. Howell).
22. Motion pictures of sea otters along the coast of central California. J. R. Pemberton (shown by A. B. Howell).

11:45 *a.m.*

Members of the Society assembled for a group picture.

2:00 *p.m.*

Members of the Society visited the Museum of Palaeontology, Hearst Mining Building, University of California.

3:30 *p.m.*

23. Effects of a wet year on mammalian populations. J. Grinnell, University of California.
24. Rodents on the desert. Charles T. Vorhies, University of Arizona.
25. Significance of numbers in mammalian ecology. Walter P. Taylor, U. S. Biological Survey.
26. The 1938 Allan Hancock Expedition. George S. Myers, Stanford University. Slides.
27. The Allan Hancock Expeditions. John S. Garth, Los Angeles, California. Moving pictures.
28. Sea Lions of the Pacific. R. M. Anderson, National Museum of Canada. Moving pictures.

7:00 *p.m.*

The Annual Dinner of the Society was held at the Berkeley Women's City Club after which Mr. O. J. Murie presented a film entitled "Animal Life of the Aleutian Islands."

FRIDAY, JULY 22

9:00 *a.m.*

29. Notes on American house mice. David Nichols, American Museum of Natural History.
30. Variation among insular mammals of Georgia Strait, British Columbia. E. Raymond Hall, University of California. Slides.
31. Food habits of peg-legged coyotes. Charles C. Sperry, U. S. Biological Survey.
32. Coyote food habits on the Lava Beds National Monument, California. Richard M. Bond, Soil Conservation Service. Slides.
33. Food habits of foxes in Minnesota. D. M. Hatfield, University of Minnesota.
34. Notes on winter food of the black bear in the George Washington National Forest, Virginia. Clarence Cottam, A. L. Nelson, and T. E. Clarke, U. S. Biological Survey and U. S. Forest Service. Slides.

35. Studies to determine the coefficient of digestion for alfalfa hay and white cedar browse for white tail deer in Michigan. L. A. Davenport, Michigan Conservation Department. Slides.
36. The present status of Canadian big game mammals. R. M. Anderson, National Museum of Canada. Slides.
37. Hormonal control of the mammary gland. William R. Lyons, University of California. Slides.

1:45 *p.m.*

38. Breeding lore and genetics. William E. Castle, University of California.
39. Some biochemical aspects of deer licks. Joseph Dixon, National Park Service.
40. Lava bed mammals and isolation. Seth B. Benson, University of California. Slides.
41. Les recherches mammalogiques actuelles en France. P. Rode, Muséum National d'Histoire Naturelle, Paris.
42. Relation of size of pocket gophers to soil and altitude. W. B. Davis, Texas A. and M. College.
43. Notes on the natural history of California coast black-tailed deer. James Moffitt, California Academy of Sciences.
44. Raising the young of red bats on an artificial diet. William H. Gates, University of Louisiana. (Read by George H. Lowery, Jr.)

4:15 *p.m.*

Final business meeting of the Society

SATURDAY, JULY 23

Members and guests enjoyed a tour of the Fleishhacker Zoo in San Francisco under the personal guidance of Edmund Heller, Director.

The afternoon was spent at the California Academy of Sciences, San Francisco, where members and guests had the opportunity to visit the North American Mammal Hall, the research collections, and the Steinhart Aquarium.

SUNDAY, JULY 24

A field trip, under the guidance of the Local Committee on Arrangements, was made to the redwoods at Big Basin in the Santa Cruz Mountains, and to the herd of sea otters near Monterey.

At the meeting of the Directors on July 19, H. E. Anthony was re-elected as trustee for 1938-1941, and Arthur H. Howell was appointed as chairman of the Editorial Board.

At the annual business meeting on July 20 the following officers were elected: President, Hartley H. T. Jackson; Vice-presidents, A. Brazier Howell and Walter P. Taylor; Recording Secretary, Robert T. Orr; Corresponding Secretary, William B. Davis; Treasurer, Viola S. Schantz. Additional Directors were elected as follows: Rudolph M. Anderson, William H. Burt, Joseph S. Dixon, Edward A. Preble, and W. E. Saunders.

William H. Gates was elected to fill the place in the Board of Directors left vacant by the election of A. H. Howell by the board to the position of Editor.

Rule *1* of the By Laws (Election of Officers) was amended to read as follows:

Nominations shall be made from the floor for officers in the following order: President, Vice-Presidents (two), Recording Secretary, Corresponding Secretary, and Treasurer. Nominations shall be made and closed for each office before proceeding to nominations for the next office herein above specified. Elections shall be by secret ballot and each member shall cast a vote for one nominee for each office. Nominees receiving

a majority of votes shall be declared elected. If the ballot results in less than a majority of votes cast for one nominee for a given office a second ballot shall be cast for the nominees receiving the two highest numbers of votes.

Following the election of officers the five Directors for membership in the council shall be nominated and elected in the same way as the President except that the five nominees for the council who receive the highest numbers of votes shall be declared elected.

During the past year the Society has learned with deep regret the deaths of the following thirteen members, six of whom (*) were charter members of the Society: Frank N. Blanchard, *Amos W. Butler, James J. Carroll, Howard E. Coffin, Henry H. Collins, *Henry H. Donaldson, Howard Fuguet, *Madison Grant, *George Bird Grinnell, F. B. Loomis, *Arthur J. Poole, *Lord Lionel Walter Rothschild, *Frank Stephens.

A summary of the report of the Corresponding Secretary follows:

New members elected at annual meeting	106
New subscriptions received since last meeting	29
Total gross additions to mailing list	135
Resignations	16
Deaths reported	13
Annual members delinquent in dues two years	41
Annual members delinquent in dues one year	71
Number of Honorary Members	4
Number of Life members	52
Number of annual members	813
Total number of members	869
Members not receiving Journal	3
Number of subscribers, paid	197
Total mailing list	951

One member, Robert Marshall, has changed from an annual member to a Life member in the past year.

It is with considerable pleasure that the Secretary can report a substantial increase in membership and an increase of nearly 12 per cent in the mailing list of the Journal over that of last year. Members will also be pleased to learn of the sound financial condition of the Society.

An invitation from the Louisiana State University, at Baton Rouge, to hold the 1939 annual meeting of the Society at that institution was accepted. George H. Lowery, Jr. was appointed chairman of the Local Committee on Arrangements for the 1939 meeting. Invitations for holding the 1940 meeting in Toronto and the 1941 meeting in Chicago were read.

Reports of the following standing committees were read and accepted: Editorial, Life History and Ecology, Anatomy and Phylogeny, Marine Mammals, Conservation, and Nomenclature. No report was made by the Committee on Bibliography, but it was the unanimous opinion of the members present that the work of this committee is well shown in each number of the Journal.

At the final business meeting on July 22, the Society passed resolutions expressing its sincere appreciation to the University of California, the California Academy of Sciences, and the Fleishhacker Zoo for the facilities incident to a most successful annual meeting. Also, to Joseph Dixon, Paul Fair, and Miss Margaret Wythe for their presentation of the Photographic Art Exhibit of Wild Animals. Especial thanks were tendered the Local Committee on Arrangements for their hospitality and for their efficiency and painstaking efforts in carrying through a well-planned, instructive, and highly interesting meeting.

The Society went on record as heartily commending the actions of the Wilderness

Society and other agencies cooperating in effecting the establishment of wilderness areas. By resolution, the Society expressed strong opposition to the diversion of water from Yellowstone Lake for commercial purposes. Also, the Society placed itself on record as being strongly opposed to any such measure as the proposed "Humane Pound Law" which, if passed, would, in effect, prohibit in the State of California the use of any animal in experimentation and research.

The Society urged, by resolution, that each state, the federal government, and all other interested agencies, public and private, both in America and throughout the world, consider the desirability of additional effective protection for species of mammals threatened with extinction.

A resolution was also passed commending the Mexican government for terminating a recent concession permitting the killing on a large scale of sealions for conversion into cat and dog food, and urging that no similar concession be granted in future.

LIST OF RECENT LITERATURE

[*Conducted by Arthur H. Howell, Remington Kellogg, and Gerrit S. Miller, Jr.*]

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ANDREWS, C. L. The decline of the sea otter. Nature Mag., vol. 29, no. 2, pp. 107–108, illus. February, 1937.

ANDREWS, ROY CHAPMAN. Speed—Humanity beaten only by an 818-miles-per-hour fly! A chart showing man outstripping beasts, birds, and fish, thanks to his invention of machinery. Illus. London News, vol. 192, no. 5150, pp. 18–19. January 1, 1938.

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——— The "Abominable Snowman" unmasked! An ursine "Man Friday." Illus. London News, vol. 191, no. 5145, p. 941, illus. November 27, 1937. (*Ursus arctos isabellinus.*)

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——— The passing of "Mo-Koumdje," the chief; known to Londoners as Mok: Drawings of the Zoo's "unique" gorilla, by Nina Scott-Langley. Illus. London News, vol. 192, no. 5153, p. 127, illus. January 22, 1938.

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——— Howlers' acrobatics in the tree-tops: Spectacular monkey-leaps. A howler's forest bridge for her baby: Monkey resourcefulness. Illus. London News, vol. 192, no. 5151, pp. 58–59. January 8, 1938.

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COMMENT AND NEWS

In the absence of the chairman of the Editorial Committee during the summer, the August number of the JOURNAL OF MAMMALOGY was carried through the press, and the November number made up, by Arthur H. Howell and Remington Kellogg.

The Society is indebted to William B. Davis for compiling the index to the current volume of the JOURNAL.

For years the Society has been actively interested in the very substantial progress that has been made in securing more adequate protection for whales. The results of its efforts along this line have, perhaps, been not inconsiderable.

In the summer of 1937 there was held at London an International Whaling Conference, and it is gratifying that all of the countries attending have either ratified or acceded to the provisions of the agreement reached at that time.

A second International Whaling Conference was held in London from June 14 to 24, 1938, attended by the delegates of 13 countries, including the United States, Great Britain, Norway, Germany and Japan. Remington Kellogg was a delegate from the United States. Additional provisions agreed to, according to the press communique issued by the conference, include the protection in Antarctic waters of humpback whales for a period of one year; establishment of a baleen whale sanctuary in the Antarctic Ocean between Graham's Land and the Ross Sea; and prohibition of pelagic whaling in the Arctic Ocean.

Two cash prizes, founded by the late Dr. William Johnson Walker, are annually offered by the Boston Society of Natural History for the best memoirs, written in English, on topics proposed by a board of trustees. The topics for 1939 are subjects in the field of general zoology. Those interested may obtain further details from Clinton V. MacCoy, secretary, Boston Society of Natural History, Boston, Massachusetts.

Many of those attending the twentieth annual meeting of the Society had the privilege of seeing the southern sea otters along the coast of Monterey County, California. It is not unlikely that this proved to be the most moving sight, from a purely mammalogical angle, that some of us have ever experienced. Certainly there are few who could reasonably have expected to see a member of this genus in life.

In direct ratio to the potential interest of this mammal is, undoubtedly, the concern of the Society in regard to the adequate perpetuation, and indeed the increase, of the existing stock.

With commendable promptitude after these animals were reported, the state Division of Fish and Game assigned a warden to their protection. But there are unusual features concerned, and more vigorous action may be necessary

The part of the coast of Monterey County along which sea otters now occur is mostly precipitous, wild, and sparsely inhabited, but with a new highway skirting it for some distance. A dozen wardens could not prevent determined harassment of the animals. Furthermore, small commercial fishing boats, many of them owned by aliens, abound.

The threat to the sea otters is of two main sorts; one because of the value of their pelts, and the other because they are alive and feed close to shore. Where the animals are most readily accessible from the highway are displayed picture postcards of them, including one with the legend "Over $25,000 in otter fur afloat." There is also a local rumor that a Hollywood actress paid a Japanese fisherman $1500. each for three pelts. It makes no difference whether or not this rumor be true, the harm done is that local residents, one and all, are aware that a sea otter pelt is the cash equivalent of many months of hard work.

Accessibility from the highway results in much disturbance of the animals. Stones and even fire-crackers are thrown from the bluff at those close to shore. Repeatedly tourists have stopped and shot at the otters, with rifle or pistol, with little likelihood of resulting trouble for the shooter, for if apprehended by a warden he could claim to be occupied in target practice at seaweed. During the summer it was stated by local residents that the sea otters were markedly more wary, and less given to gathering in bands, than three months previously.

It seems evident that in addition to a patrol service as effective as practicable, this part of the coast line should be made a wild life sanctuary, with discharge of firearms prohibited.

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